UGANDA PROTECTORATE.

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ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

YEAR ENDED 31ST DECEMBER, 1934.

(PART II).

PRICE: SHS. 4/-.

Published by Command of His Excellency the Governor

ENTEBBE:
PRINTED BY THE GOVERNMENT PRINTER, UGANDA.
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Introduction.

As in previous years, Part II. of the Annual Report deals primarily with experimental work, and unlike Part I., covers the period from 30th June, 1934, to 30th June, 1935.

2. This year a separate report on the Kampala Plantation has not been included, as, with the exception of certain experiments, the results of which are incorporated in the reports of the various sections of the Laboratories Division, the bulk of the work is not experimental.

3. Although the work is reported separately by the heads of the several sections or units concerned it is essentially team work and the individual reports do not necessarily present a complete picture of the work done by the section concerned. The Chemist, for instance, is concerned with a number of the experiments discussed in the Entomologist's report. Similarly it will be found that some of the Entomological work is reported in the Mycological Section.

4. Of particular interest this year are the results of the Cotton Breeding Work. For a number of years cottons from all over the world have been experimented with in order to find or to evolve types suitable for our market and adapted to Uganda conditions of soil and climate. Among these introductions we received a few years ago a variety from Mr. Parnell, of the Barberton Research Station, called U. 4. Grown in Uganda it had a much higher yielding capacity than our local N. 17 or any of its derivatives and was highly resistant to Blackarm disease and to Jassid attack. The lint was so short and harsh, however, as to be useless. Selections have been made at Serere, however, and several very promising strains evolved. One of these, S.P. 87, has lint fully equal to Local, gives a much higher yield, and retains the original high degree of resistance to Blackarm disease and to Jassid attack.

5. An improved cotton is also an urgent requirement for Buganda and it is satisfactory to be able to report a very promising strain in B.P. 50 originally selected from Local cotton. The yield is equal to Local, the ginning outturn better while the lint is longer, stronger and more uniform than that of Local.

6. In the Entomological Section will be found the first data obtained from the Soil Climate Insect plots. It is clear that in the course of time these plots will yield valuable data capable of statistical analysis on many of the insect problems concerned with cotton.

7. The Pink Bollworm has not been reported upon at any great length because it is forming the subject of a special investigation by Mr. Taylor, who arrived in Uganda only in February.

8. The sowing date experiments in Usuku have confirmed earlier ones that it is possible to plant cotton in April in this area. This has now been built into our propaganda and this year (1935) a substantial area has been planted in April. As a result an increase in cotton production in the area can be expected with confidence.

9. Interplanting cotton with groundnuts has also been the subject of further trials and it is becoming clear that if the planting is done at the proper time and if weather conditions are normal the practice results in an increased cotton crop and in the production of some groundnuts. These results may prove to have a fairly wide application in Uganda.

10. The use of cut mulch in various forms such as elephant grass, short grass, banana leaves and stems, and on various crops such as coffee, cotton and groundnuts, again gives interesting results some of which, particularly in the case of coffee, have already been introduced widely into native agricultural practice with great success.

11. It is impossible in this introduction to call attention to more than a fraction of the results being obtained from the diverse series of experiments in progress all of which are designed to promote agricultural development upon the soundest possible lines.

12. I wish to take this opportunity of expressing my most cordial thanks to the Sudan Government Authorities and to the Agricultural Authorities in Egypt for enabling Mr. Taylor and myself to see their methods of dealing with Pink Bollworm and to see so much of the work on agricultural problems generally going on in those territories.

13. Finally, it is a pleasant duty to acknowledge the excellent team and individual work done by all those who have contributed toward this report.

J. D. TOTHILL,

Director of Agriculture.

ANNUAL REPORT ON THE EXPERIMENTAL WORK DONE IN THE EASTERN DIVISION 1934.

The experimental work other than that on coffee is done at the Serere Experiment Station and the subsidiary farms at Ngetta, Wanyange, and Mbale, and in District plots outside those stations. The Bugusege Plantation is concerned entirely with work on Arabica coffee.

1. SERERE EXPERIMENT STATION.—This now consists of three sections:—

(*a*) *The Experiment Farm* of 50 acres, being five 10-acre blocks cropped on the rotation:

1st year	...	Cotton Experiments.
2nd year	...	Groundnuts and Millet (*Eleusine*) Experiments. Put down to grass in the late rains.
3rd—4th years	...	Grass (*Panicum maximum*).
5th year	...	Ploughed up and planted with green cover.

A dressing of farm yard manure or compost is put on after the cotton.

(*b*) *The Old Farm* of 80 acres, being eight 10-acre blocks, of which five are now either under grass or being allowed to assume a natural cover, one is under trees, and two are to be used for silage production.

(*c*) *The New Seed Farms*, being five blocks, of 40 acres each, which were laid out in 1933 and which are to be opened year by year for use as multiplication areas for cotton and possibly groundnuts. Each of these areas of forty acres (known as the 1934 Farm, 1935 Farm, etc.) is laid out more or less along the contours below Gola hill, and is divided up into strips by wide shallow drains, each drain occuring at an interval of 5′ vertical fall.

The rotation is:

1st year	...	Cotton 40 acres.
2nd year	...	Groundnuts 20 acres, Eleusine 20 acres. Put down to grass in the late rains.
3rd—5th years	...	Grass Fallow.
6th year	...	Ploughed up and planted with green cover crop.

The 1934 Farm was brought into use during the year for the increase of the cotton S.P. 1.

2. *Ngetta Farm.*—This is financed from the Native Administration Fund of Lango District. It is about 50 acres in area and is divided into two rotations—

	(*a*) *Six blocks of 6 acres.*	(*b*) *Six blocks of 2 acres.*
1st year	Early Cotton.	Eleusine and Cajanus.
2nd year	Eleusine.	Sweet Potatoes followed by Millet.
	Late Cotton.	Beans followed by Sweet Potatoes.
3rd year	Groundnuts.	Cassava.
	Sim-sim.	
4th year	Put down to grass.	Put down to grass.
5th year	Grazing.	Grazing.
6th year	Grazing.	Grazing.

3. *Wanyange Farm.*—This consists of about 25 acres of land, twelve acres of which are under rotation, five acres Oil Palm, and about four acres Robusta Coffee. The farm is supported financially by the Busoga Native Administration. The work here will shortly be reorganised for demonstration of a model holding, instead of small plot experiments.

4. *Mbale Farm.*—This is a new farm opened in 1934 by means of a grant from the Bugwere Native Administration. The area is about 30 acres. Two different rotations are in use:—

	(*a*) *Five blocks of 4 acres.*	(*b*) *Four plots of ½ acre.*
1st year	Groundnuts.	
	Cowpea 2 acres.	Sweet Potatoes.
	Millet 2 acres.	
2nd year	Early Cotton.	Sim-sim.
3rd year	Eleusine.	Edible Canna.
	Late Cotton.	
4th year	Grass.	Fallow.
5th year	Grass.	

5. *Bugusege Plantation.*—(*See under* Coffee).

SECTION 1.—GROUNDNUTS.

SPACING, MULCHING, AND VARIETY TRIALS.

Object.—Previous groundnut experiments have indicated that the bunch groundnut is superior in yield to the spreading type but this was not the case in 1933. The effect of mulching has increased the yield of spreading groundnuts.

Small spacings have been found advantageous with bunch, and inconclusive with the spreading type. The present experiment tests the optimum spacing for both types and the effect of mulching on both types at various spacings.

Centres.—The trial was done at
Serere,
Ngetta,
Wanyange,
Mbale.

Treatments.—Varieties—Bunch and Spreading types.
Spacings—12 ins. by 12 ins.
9 ins. by 9 ins.
6 ins. by 6 ins.
Mulching—Mulched and not Mulched.

Lay-out.—At each centre:—Six blocks, sub-blocked for varieties with spacing and mulching randomised within the sub-blocks.

Results.—The lay-out using four centres has proved to be very sensitive but as this is a summary rather than a full statistical report the following total yields and general conclusions should suffice to indicate the results.

COMBINED YIELDS IN LBS. UNSHELLED NUTS, FROM FOUR CENTRES.

Treatments.		Total Yield.	Lbs. per Acre.
Varieties	Bunch ...	3,009	1,248
	Spreading ...	2,290	952
Mulching	Mulched ...	2,716	1,127
	Not Mulched ...	2,583	1,072
Spacings	6 in. by 6 in. ...	1,980	1,237
	9 in. by 9 in. ...	1,770	1,106
	12 in. by 12 in. ...	1,550	969

The superiority of Bunch over Spreading, Mulched over non-Mulched, 6 ins. by 6 ins. spacing over 9 ins. by 9 ins. spacing, and 9 ins. by 9 ins. over 12 ins. by 12 ins. spacing are all statistically significant.

Mulching greatly increased the yield of the Bunch, but had no effect on Spreading type. Thus:—

	Yield in lbs. per Acre.	
	Bunch.	Spreading.
Mulched	1,332	912
Not Mulched	1,150	980

SECTION 2.—COTTON.

SOWING DATE AND SPACING TRIALS.

Object.—While it is known that May cotton and spacing of about 3 ft. by 1 ft. give better results than cotton planted later and at wider spacing, experiments were carried out to confirm these conclusions in different districts.

(1) Experiment at Wanyange.

Treatments.—Spacings—3 ft. by 6 ins.
3 ft. by 1 ft.
3 ft. by 1 ft. 6 ins.
3 ft. by 2 ft.
3 ft. by 2 ft. 6 ins.
3 ft. by 3 ft.

Sowing Dates—May,
June,
July,
August.

Lay-out.—Six blocks, sub-blocked for sowing dates.

Results.—The plots planted in June failed completely owing to a long period of drought. Yields of the other treatments were:—

Yields Expressed as Lbs. per Acre.

Spacings.	Yields.	Sowing Dates.	Yield.
3 ft. by 6 in.	1,000		
3 ft. by 1 ft.	970	May	1,203
3 ft. by 1 ft. 6 in.	1,045	June	—
3 ft. by 2 ft.	922	July	820
3 ft. by 2 ft. 6 in.	842	August	683
3 ft. by 3 ft.	838		

The statistical analysis shows a very high significance for May cotton as compared with July and August. Spacings of 3 ft. by 6 ins. and 3 ft. by 1 ft. 6 ins. are significantly greater than the two widest spacings and in this experiment May sowing at 3 ft. by 1½ ft. spacing was the optimum.

When worked out on the yield of clean cotton, the optimum spacing and date were the same.

(2) Experiment at Mbale.

Treatments.—Spacings—3 ft. by 6 ins.
3 ft. by 12 ins.
3 ft. by 18 ins.

Sowing Dates—May,
June,
July,
August.

Lay-out.—Five blocks, sub-blocked for sowing dates.

Results.—Owing to an error in planting one block was abandoned. The results worked out on four blocks indicate early planting to be the best but there was no significant difference between the yields of spacing treatments.

Object.—Previous spacing and sowing date trials have been carried out with standard varieties of cotton. It was desired to test the variety S.P. 1 for Lango conditions, to find out whether very early planting was successful, and to combine close spacing with these variates.

(3) Ngetta. Late Spacing Experiment with S.P. 1.

Treatments.—Spacings—3 ft by 6 ins.
3 ft. by 12 ins.
3 ft. by 18 ins.

Sowing Dates—June,
July,
August.

Lay-out.—Six blocks, sub-blocked for sowing dates.

Results.—The yields per acre calculated from the plot yields are given below:—

YIELDS OF COTTON IN LBS. PER ACRE.

Specings.	Yields.	Sowing Dates.	Yield.
3 ft. by 6 ins.	656	June	705
3 ft. by 12 ins.	586	July	710
3 ft. by 18 ins.	511	August	337

With the variety S.P. 1 the close spacing 3 ft by 6 ins. was significantly better than 3 ft. by 12 ins. and the latter was better than 3 ft. by 18 ins. In sowing dates June and July were equal and better than August.

(4) NGETTA.—EARLY SOWING DATE EXPERIMENT WITH S.P. 1 AND N. 17.

Treatments.—Varieties—N. 17 (Local), S.P. 1.
Sowing Dates—April,
May,
June.

Lay-out.—Six blocks, sub-blocked for varieties.

Results.—The yields calculated from the plot results and expressed per acre were:—

YIELDS OF COTTON IN LBS. PER ACRE.

Varieties.	Yield.	Sowing Dates.	Yield.
—	—		
		April	361
N. 17	295	May	356
S. P. 1	417	June	350

The yield of the S.P. 1 variety was significantly higher than N. 17. There was no disadvantage in planting either variety in April.

(5) SOWING DATE TRIALS IN EARLY DISTRICTS.

(*a*) Observation strips of cotton planted monthly throughout the rainy period indicated that earlier planting than that generally adopted would prove the best for Usuku County of Teso District.

These observations were followed by replicated experiments, which confirmed the results, and these were repeated in 1934.

Treatments.—4 Sowing Dates—April,
May,
June,
July.

Lay-out.—Six randomised blocks.

Centres.—Katakwe, Toroma.

Results.—The yields of the combined trials were as given below.

Date Planted.	Yield in lbs. per acre.
April	385
May	283
June	98
July	84

The differences between April, May, and June cotton were all significant by Fisher's method.

Conclusions.—The results obtained from observation strips, and the 1933 and 1934 experiments are considered to be conclusive. Usuku cotton growers are now advised to plant as much of their cotton as possible in April, and no further experiments are necessary.

(*b*) Observation plots were put down at Cheptui, on the plains of North Bugishu, to find out the best planting month. Plots were planted once a fortnight from April to September. The yields are shown below.

Date Sown.	*Yield per acre—lbs.*
April 30th	805
May 15th	540
May 30th	605
June 15th	523
June 30th	335
July 15th	330
July 30th	303
August 15th	80
August 30th	30
September 15th	0

The climate of Usuku and the Cheptui area is hot and the growing period short. Taken in conjunction with the Usuku experiments the Cheptui results are considered sufficient evidence upon which to base propaganda for early planting.

COTTON CULTIVATION EXPERIMENT.

Object.—To test the growing of cotton on mounds and ridges in Usuku county of Teso, where root development is apt to be restricted owing to the nature of the soil.

Treatments.—Large Mounds made from 4 ft. square, 5 plants per mound.
Small ,, ,, ,, 3 ft. ,, 3 ,, ,, ,,
Ridges ... ... 4 ft. apart, 48 ,, ,, ridge.
Control (flat) ... ... 36 ,, ,, row.

Lay-out.—Six blocks of four treatments, done at two centres, Katakwe and Toroma. All plots planted in May.

Results.—The mean yields of the two experiments combined were—

Large Mounds	290 lbs. per acre.
Small ,,	276 ,, ,, ,,
Ridges	334 ,, ,, ,,
Control (flat)	242 ,, ,, ,,

The statistical analysis of these results showed no significant differences between the two types of mounds. The ridges were, however, significantly better than the mounds and the control (cultivation on the flat). The large mounds were also better than the control. The 1933 results did not give any such indications, and the experiment is to be repeated.

Break Pan Experiment.

Object.—To ascertain whether, by growing Kapenda (*Cajanus indicus*) before cotton, the pan which is presumed to be present in some of the soils in Usuku county can be sufficiently broken up to allow the cotton roots to penetrate further, and in consequence improve the yield. Cowpea sown on the control plots.

Centres.—Katakwe and Toroma.

Lay-out.—Five pairs of plots, one of each pair under *Cajanus* and the other under Cowpea. The Katakwe plots were 63 ft. by 30 ft. and the Toroma plots 36 ft. by 51 ft. *Cajanus* and Cowpea were planted on 3rd September, 1931, neither crop grew well.

Cotton was planted in May 1932.

Results, 1932.

Katakwe.				Toroma.			
Plots.	Treatment.	Total ozs.	Means.	Plots.	Treatments.	Total ozs.	Means.
1, 3, 6, 8, 9	Cotton after Cajanus	484	96·8	2, 3, 6, 8, 9	Cotton after Cajanus	355	71·0
2, 4, 5, 7, 10	Cotton after Cowpea	512	102·4	1, 4, 5, 7, 10	Cotton after Cowpea	444	88·8

There is no significance on analysis of these figures according to Fisher's Method.

1933-34.

This experiment was repeated at the same centres in 1933-34.

The plots at both centres were 66 ft. by 33 ft. The Kapenda plots were planted in May 1933 and a fair crop was harvested. The Cowpea all died owing to the drought, so no crop was harvested.

The Cotton was planted at both centres in May 1934 and the following are the results.

Results.— MEAN YIELDS IN OZS.

	TOROMA.	KATAKWE.
Cotton after Cajanus	93·5	165·2
(Control) Cotton after Cowpea	144·0	231·8

THE TOTAL MEANS AT BOTH CENTRES FOR THE TWO YEARS.

	Cajanus Plots.	*Cowpea Plots (Control).*
	96·8 ozs.	102·4 ozs.
	71·0 ,, ...	88·8 ,,
	165·2 ,, ...	231·8 ,,
	93·5 ,, ...	144·3 ,,
Totals ...	426·5 ,, ...	567·3 ,,
Mean of Means	106·5 ,, ...	141·8 ,,

Statistically this gives no significant difference.

A number of the Cotton plants were dug up from all plots. There was no root branching at any definite depth or any indication that a pan was present. The experiment is now concluded.

COTTON AND GROUNDNUTS INTERPLANTING EXPERIMENT.

Object.—To find the effect of growing groundnuts between the rows of cotton and to determine whether the combined yields from both crops would make interplanting worth while.

The 1933 experiments at Ngetta and Kaberamaido indicated that interplanting with bunch groundnuts was advantageous, but spreading groundnuts interplanted gave a smaller return than cotton alone. The whole experiment was repeated at Kaberamaido. The Ngetta trial was confined to bunch groundnuts, and three sowing dates were used instead of one.

(1) KABERAMAIDO EXPERIMENT.

This was planted in June being five weeks earlier than the 1933 trial. There were 8 spacing treatments replicated 5 times for each variety of groundnuts.

The results have been expressed as returns per acre with cotton valued at 11 cents per pound and groundnuts at 2 cents per pound being the approximate market value of these crops at harvest time.

Treatment.	Cash Return per Acre.	
	Cotton and Bunch Groundnuts.	Cotton and Spreading Groundnuts.
	Shs. cts.	Shs. cts.
1. Cotton alone 3 ft. by 1 ft.	83 16	88 44
2. Groundnuts alone 9 in. by 9 in.	55 68	38 40
3. Cotton 3 ft. by 1 ft. and one row groundnuts ...	99 00	101 64
4. Cotton 3 ft. by 1 ft. and two rows groundnuts ...	107 40	67 32
5. Cotton 4 ft. by 1 ft. and three rows groundnuts ...	118 44	83 16
6. Cotton 4 ft. by 1 ft. and four rows groundnuts ..	101 16	72 24
7. Cotton 6 ft. by 1 ft. and six rows groundnuts ...	94 32	73 44
8. Cotton 6 ft. by 1 ft. and seven rows groundnuts ...	95 40	68 28

(2) Ngetta Experiment.

Treatments.—Cotton alone 3 ft. by 1 ft.
Cotton 3 ft by 1 ft. and 1 row bunch groundnuts.
Cotton 3 ft by 1 ft. and 2 rows ,, ,,
Sowing Dates—May,
June,
July.

Lay-out.—72 plots, 8 blocks, sub-blocked for sowing dates.

Results.—Cash returns per acre calculated from the yields per plot valued at 11 cents per lb. for cotton and 2 cents per lb. for groundnuts were—

Sowing Date.	May.	June.	July.
	Shs. cts.	Shs. cts.	Shs. cts.
Cotton	25 10	38 96	32 70
Cotton and 1 row Groundnuts	28 84	41 94	40 22
Cotton and 2 rows Groundnuts	32 89	38 85	35 37

Summary of Results.—Greater cash returns were obtained by interplanting bunch groundnuts in cotton than by growing cotton alone. This agrees with previous experience. As far as Ngetta is concerned the best month for growing cotton interplanted with groundnuts was June.

With spreading groundnuts one row interplanted in cotton was advantageous. This did not agree with the 1933 experiment, but the results of the other treatments did conform with it in indicating that more than one row reduces the cash return.

SECTION 3.—COFFEE.

BUGUSEGE EXPERIMENTS (*Arabica Coffee*).

(1) Pruning Experiment, 1927.

Object.—To compare the yield obtained from the Single Stem, Multiple Stem, and Agobiada pruning systems.

Lay-out.—Eight randomised blocks, the sub-plots containing 7 rows of 8 trees spaced at 8 ft. by 8 ft.

Results.—The Agobiada treatment has given the highest yield over the six seasons 1929—1934.

Total Yields of Plots in Lbs. Cherry.

Season.	Single Stem.	Multiple Stem.	Agobiada.	Total.
1929	740	517	498	1,755
1930	2,957	3,324	4,455	10,736
1931	689	823	3,565	5,077
1932	5,278	6,428	9,065	20,771
1933	956	4,778	4,287	10,021
1934	3,593	3,257	6,718	13,568
Total	14,213	19,127	28,588	...

The Least Significant Difference between Treatments is 3,717 lbs.
,, ,, ,, ,, ,, Seasons is 2,628 lbs.

With the exception of the first and the fifth crops the Agobiada treatment has been superior to the other treatments and the cumulative differences are great. It is now noticeable, however, that the bean from Agobiada trees is smaller than that from trees pruned on the Single and Multiple stem systems and in future comparisons the "grading out turn" and cash value will have to be taken into account.

(2) Pruning Experiment, 1930.

Object.—To test a simple form of multiple stem pruning which may be suitable for natives to use, against natural growth and Agobiada pruning.

Lay-out.—Six randomised blocks of 3 plots.
Each plot contains 6 rows of 8 trees at 8 ft. by 8 ft. spacing.

Results.—A small crop was picked in 1932, a big one in the following year, and a moderate one in 1934. The following total yields of cherry have been obtained.

Natural Growth	2,050 lbs.
Agobiada	1,031 ,,
Modified Multiple Stem	3,283 ,,

All these differences are significant, the L.S.D. being 456 lbs. No conclusions can be drawn from these results until the multiple stem trees have passed through a complete cycle.

(3) Manuring (Cultural) Experiment, 1928.

Object.—To compare the yields of coffee maintained under five cultural treatments, as follows:—

A. Clean Weeded.
B. Green manure—two covers per annum.
C. Banana leaf mulch.
D. Weed Cover dug in twice a year.
E. Leguminous cover crop from October to March and clean weeded for the rest of the year.

Lay-out.—A 5 by 5 Latin square each sub-plot containing 5 rows of 8 trees spaced 8 ft. by 8 ft. The trees were pruned on the single stem system up to 1930 since when they have been allowed unlimited terminal growth.

Results.—Yields for five seasons are given below—

Total Yields of Plots in Lbs. Cherry.

Season.	Treatments.					
	Clean Weeded.	Two Cover Crops.	Banana Mulch.	Weed Cover.	One Cover Crop.	Season Totals.
1930-1	947	918	840	1,025	959	4,689
1931-2	2,039	1,575	1,951	1,277	2,025	8,867
1932-3	1,343	1,718	1,977	1,001	2,079	8,118
1933-4	2,789	1,702	1,988	1,909	2,290	10,678
1934-5	1,512	1,168	1,760	592	1,093	6,125
Treatment Totals ...	8,630	7,081	8,516	5,804	8,446	38,477

The least significant difference for Treatment and Season is 1,007 lbs.

In the total yields Clean Weeded, Banana Mulch and October—March cover are all significantly better than Two cover crops and Weed Cover.

Clean weeding appears to do well in high yielding years. Banana mulch seems to avoid large fluctuations in yield from year to year.

(4) Cultural Experiment, 1932.

Object.—To compare the yields obtained from coffee maintained under five different cultural treatments when pruned on the Modified Multiple Stem system.

A. Clean Weeded.
B. Green Manuare—two covers per annum.
C. Banana leaf mulch.
D. Weed Cover, dug in twice a year.
E. October—March cover crop, clean weeded for the rest of the year.
F. Banana leaf mulch and stems.
G. *Leucaena glauca* shade, with lines slashed back for green manuring.

Lay-out.—5 randomised blocks of 7 plots, each plot containing 5 rows of 6 trees planted at 6 ft. by 6 ft. spacing with three-foot lanes between plots.

Results.—Four treatments gave their first crop, yields of cherry being as shown below—

Clean Weeded	104 lbs.
Green Manure 2 covers a year	nil.
Banana leaf mulch	538 ,,
Weed Cover	nil.
October—March Cover	nil.
Banana leaf mulch and stems	631 ,,
L. glauca	115 ,,

(5) Spacing and Pruning Experiment, 1932.

Object.—To determine the optimum spacing for arabica coffee in Bugishu, under natural growth as compared with pruned trees.

Treatments.—Spacings—8 ft. by 8 ft.
7 ft. by 7 ft.
6 ft. by 6 ft.
4 ft. by 4 ft.
Pruning—Natural Growth.
Modified Multiple Stem.

Lay-out.—Five randomised blocks of eight plots.

Results.—The first crop occurred in 1934 and the following total yields of cherry were obtained from the plots of each treatment.

Spacing.	8 ft. by 8 ft	7 ft. by 7 ft.	6 ft. by 6 ft.	4 ft. by 4 ft.	Total.
Natural Growth	569	651	730	1,674	3,624
Modified Multiple Stem	274	331	737	481	1,823
Totals	843	982	1,467	2,155	5,447

These first crop results correspond to expectation when it is considered that the modified multiple stem trees had their growth checked by being topped in the nursery. Also the 4 ft. by 4 ft. spacing when the trees ars small, and before they begin to compete for room, would be expected to give a higher yield per plot.

(6) Shade Experiment, 1932.

Object.—To observe the effect of different periods of shade, and of permanent shade, on the yield of arabica coffee.

Treatments.—Shade is provided by bamboo slats placed on frames over the plots.—

(*a*) Shade removed gradually during a period of one month before flowering, the trees remaining unshaded for one month, after which the shade is gradually returned during the third month.

(*b*) The shade is removed one month earlier than (*a*).

(*c*) The shade is removed one month earlier than (*b*).

(*d*) Permanent shade of the same intensity as (*a*), (*b*) and (*c*).

(*e*) No shade, control.

Lay-out.—A five by five Latin square.

Results.—The first crop was picked in the 1934 season. No significant differences in yield were shown and as the first crop is not important the figures are not given.

ROBUSTA COFFEE.

In view of the distribution of Robusta coffee trees to natives of Busoga some experimental and demonstration work is being done in that district.

(1) Shade and Variety Experiment.

Object.—To find out whether the Erect or the Nganda type of Robusta is the more suitable for Busoga conditions, and whether either needs shade.

Lay-out.—Nganda and Erect Robusta, with and without *Gliricidia* shade.
Five blocks of 4 plots each.

The experiment was planted in September at Wanyange.

(2) Progeny Rows.

Two rows each of the Assistant Botanist's selections Nos. 35, 233, 225, 236, 220, and 238 have been planted out for observation at Wanyange.

(3) Demonstration Plots.

(*a*) *Busoga.*—Plots have been laid down at Nasuti and Nawanzu to demonstrate Robusta growing. In each case there are four plots with Nganda and Erect types, shaded and unshaded.

(*b*) *Bugwere and Budama.*—Trial plots of 25 trees each were planted at Kabwangasi, Budaka, Iki-iki, Kibale, Napopongo, Malera, Kidongole, Buseta, Kachumbala, Butebo and at Buteleja, Mulanda, Busaba, Budumba and Bulumbi.

Shade versus no shade plots were laid down at Buteleja and Mulanda.

SECTION 4.—OTHER CROPS.

TOBACCO.

Trial plots of tobacco of an air curing type were grown for the first time in Chua, Lango, Teso, Bugishu and Busoga. The variety used for the early rains was Amorella. The plots met with varying success. The abnormally long dry period in June was against them and better conditions would be expected in other years.

Reports on the quality of the leaf were promising as regards tobacco from Padibe (Chua), Sipi (Bugishu) and Bugaya (Busoga). The Teso plots produced short leaf rather lacking in gum, but yielded well.

Trial plots were again put down in the second half of the year but the climate does not appear to be suitable for a second crop, and the 1935 trials will be planted in the early rains.

CASSAVA.

(1) Owing to the spread of mosaic disease in the cassava crop in Teso and other districts, arrangements have been made to test imported varieties and local stock with the object of finding their relative yields and resistance to disease. The following experiment has been planned—

Treatments.—10 Varieties—Mugowa, Smalling, Brownstick, Bobby Hanson, Nyumbezunga, Bunch of Keys, Numbu, Node-wide, Nakasuga and Local.

Lay-out.—Four randomised blocks, to be planted at three centres. The first, at Serere has been planted.

(2) A block of cassava was planted at Ngetta in May 1933 for the determination of the best length of time to leave the crop in the ground before harvesting. Strips of one ¼ acre dug up at two-monthly intervals gave the following yields (per acre)—

10	months	...	...	...	...	...	7,092 lbs.
12	,,	...	...	...	...	...	7,356 ,,
14	,,	...	...	...	...	...	9,252 ,,
16	,,	...	...	...	...	...	12,216 ,,
18	,,	...	...	...	...	...	15,020 ,,
20	,,	...	...	...	...	...	15,636 ,,

OIL PALM.

Five acres of oil palm were planted at Serere and five at Wanyange in 1931. The Wanyange palms are in the more advanced condition and one tree has borne fruit during the year.

SECTION 5.—FERTILITY EXPERIMENTS.

FARMYARD MANURE.

1. *Object.*—To compare varying amounts of Farmyard Manure, Green Manure, and Green Manure with Lime as a measure for retention of fertility. The experiment was put down at Serere in 1933.

Lay-out.—A 5 by 5 Latin Square of the following treatments:—

1. Green Manure (*Crotalaria juncea*).
2. Lime 2 tons per acre and green manure.
3. Farmyard manure 10 tons per acre.
4. ,, ,, 20 ,, ,, ,,
5. ,, ,, 30 ,, ,, ,,

The manure and green manure come before cotton and after groundnuts.

Results.—The rotation is:

1st year	... ...	Cotton.
2nd year	... ...	Bulo (Eleusine).
		Cotton.
3rd year	... ...	Groundnuts.

The manure had no significant effect on the yield of the first cototn crop but the second crop (planted after the millet in 1934) showed that the treatments of 10 tons, 20 tons and 30 tons applied two years ago gave significantly higher yields than lime and green manure alone.

2. Manuring observation plots put down at Ngetta gave the following yields from single plots:—

Sim-sim	(*a*) Following *Cajanus* green manure	3 lbs.
	(*b*) Control, no manure	1½ ,,
	(*c*) Following farm yard manure	2 ,,
Groundnuts ...	(*a*) Following green manure	24 ,,
	(*b*) Control	25 ,,
	(*c*) Following farm yard manure	35 ,,
Millet (sorghum) ...	(*a*) Following green manure	72 ,,
	(*b*) Control	57 ,,
	(*c*) Following farm yard manure	62 ,,
Sweet Potatoes ...	(*a*) Following green manure	273 ,,
	(*b*) Control	314 ,,
	(*c*) Following farm yard manure	344 ,,

The farm yard manure has in all cases improved on the control plots but the effect of green manure was uncertain.

Compost.—The Indore system of making compost is being followed at Serere, the output at the end of the year being 1 ton per day.

The bedding used, in order to avoid reducing the grazing on the station, is the unpalatable grass *Imperata cylindrica*. Probably because of the use of a single material, the process takes slightly longer than at Indore. The Serere compost is ready after 95—100 days.

REGENERATION OF OLD LAND.

One acre of land at Ngetta which has been cropped since 1927 has been divided up into strips for cropping as under:—

(*a*) Lucerne.
(*b*) Grass mixture, grazed.
(*c*) Natural Vegetation, grazed.
(*d*) ,, ,, not grazed.
(*e*) Grass mixture, not grazed.
(*f*) Clean weeded.
(*g*) A sequence of leguminous crops as green manures.

The soil on each strip has been sampled. Further samples will be taken annually. After a period of years the fertility of the plots will be assessed by growing an index crop.

CASSAVA AS A RESTING CROP.

It is normal practice to put land down to cassave at the end of a rotation. At the old Kamuge farm one acre has been divided up into ten 1/20th acre plots of cassava and ten 1/20th acre plots of grass. In 1937 the cassava will be harvested and the grass ploughed in. An index crop or rotation of crops will be grown over the experiment in order to obtain a comparison between grass and cassava as regenerators.

EXHAUSTION EXPERIMENT.

A small plot at each experiment station is being cropped to exhaustion in order to find out how long land will stand up to continuous cropping without manure.

OTHER EXPERIMENTS.

A larger scheme of experiments on the effect of erosion, rotations, manuring, green manuring, ploughing, length of cultivation, and grazing, on the fertility of land was prepared in conjunction with the Agricultural Chemist and it is hoped to put down a comprehensive trial in the coming year.

C. E. J. BIGGS,

Senior Agricultural Officer, Eastern Division.

REPORT ON BUKALASA EXPERIMENT STATION FOR THE SEASON 1934/1935.

Introduction.

The work of the Botanical and Educational sections carried on at Bukalasa is reported under the sectional reports.

There were no alterations in the general practice of cultivation on the plantation but special attention to erosion was continued and the measures adopted to check it were comparatively successful. One block (C) which suffers badly from soil wash was planted up with sweet potatoes in ridges along the contours; this completely checked any soil wash whatsoever. Part of the new land was opened up during the year and 16 acres of it were planted up with the cotton variety S.G. 23/8 for increase purposes.

Anti-mosquito measures have been continued and the draining of swampy land has proceeded. The mosquito population has declined considerably and the mosquito observer has difficulty in finding larvæ of *Anopheles* spp.

Labour has not been so plentiful as in past years and at times considerable difficulty has been experienced in obtaining sufficient porters. Lack of really good headmen is another difficulty which has not yet been overcome. The general health of the plantation employees was good but severe epidemics of colds and 'flu occurred two or three times.

Meteorology.

Again conditions were unusually dry at critical periods which resulted in late planting of groundnuts and a delay in cotton planting. Bukalasa would appear to be situated in a small area which is considerably drier than the surrounding neighbourhood and in which the rains break from 10—15 days later. The effect of this is seen in our coffee flowering and ripening which occurs much later than elsewhere.

No serious hail storms occurred during the season.

The "dry" period January to March was really dry, unlike most of the country, and this undoubtedly was largely responsible for the high cotton yields we obtained this year.

Cotton.

1. GENERAL.—The average yield obtained over the main plantation was higher than last year, at 1,000 lbs. of seed cotton per acre. The grade was good and the percentage of "fifi" cotton low. Cotton seed was used as a manure on most plots at the rate of 4—5 tons per acre.

2. EXPERIMENTS.—(*a*) *Tractor versus Native Cultivation Combined with 3 ft. by 1 ft. Spacing Against Control (4 ft. by 1½ ft.)*—The hand-hoed plots again showed up as being more weedy but the final results showed no difference in yield between the two methods of cultivation. On the other hand, the closer spacing again gave a significant increase in yield.

TABLE I.—POUNDS OF SEED COTTON PER ACRE.

Treatment.	3 ft. by 1 ft.	4 ft. by 1½ ft.	Mean.	Least Significant Difference
Tractor	821	717	769	
Hoe	842	585	714	...
Mean	831	651	741	86

(*b*) *Topping Experiment.*—The experiment to test the effect of topping the plants at the time of flowering was repeated. A considerable suppression of vegetative growth occurred in the topped plants, which remained 12—18 inches shorter than control throughout the season. The results showed no significance.

(*c*) *Two Plants per Hole Against One.*—A good stand of two plants per hole was obtained so that the test this season was a true one. The results were not significant although indications were obtained that a slightly higher yield was obtained with two plants per hole. This is in accordance with results obtained elsewhere and no objection to the practice of leaving two plants per hole can be raised.

(*d*) *Interplanting Experiment.*—This was repeated with slight modifications made after last season's results. As the table below shows not only is a greater cash return again obtained from interplanting but this year the effect of interplanting has actually been to increase the yield of cotton.

TABLE II.

Treatment.	Yield of groundnuts (unshelled) per acre.	Yield of beans per acre.	Yield of seed cotton per acre.	Percentage of fifi.
	lbs.	lbs.	lbs.	
Control	...	...	872	12·6
Interplanted one row groundnuts ...	480	...	1,120	12·3
Two rows of groundnuts	760	...	1,080	13·6
One row of beans	...	476	1,284	12·8
Two rows of beans	...	644	1,248	13·2
Least Significant Difference	...	...	146	...

The results, which are very significant, show that one row of beans has given a significant increase in the yield of cotton over all other treatments except in the case of two rows of beans. Two rows of beans have given an increase over control and two rows of groundnuts ; all treatments have given an increase in yield over control.

The following table shows the cash returns from the various treatments worked out on an acre basis :—

TABLE III.

Treatment.	Value of groundnuts at 6 cents per lb.	Value of beans at 4 cents.	Value of Safi cotton at 12½ cents.	Value of fifi cotton at 4 cents.	Value of cotton crop.	Total cash returns per acre.	Increase return over control.
					Shs. cts.	Shs. cts.	Shs. cts.
Control	...	...	95·25	4·40	99 65	99 65	...
One row of groundnuts ...	28·80	...	122·75	5·52	128 27	157 07	+57 42
Two rows of groundnuts ...	43·60	...	116·63	5·88	122 51	166 11	+66 46
One row of beans ...	...	19·04	139·87	6·60	146 47	165 51	+65 86
Two rows of beans ...	...	25·76	135·50	6·56	142 06	167 84	+68 17

The net profit would naturally be slightly less as the extra cost of sowing and harvesting the nuts and beans would have to be deducted.

A test for any residual effect will be carried out in the forthcoming season with a crop of groundnuts followed by cotton.

(*e*) *Mulching.*—In previous seasons a 6-inch mulch of elephant grass has consistently given a significant increase in yield with August sown (*i.e.*, late sown) cotton. The cost of mulching, however, more than outweighed the increased value of the crop and therefore the experiment was modified this season, the mulch applied being only 3 ins. deep, thus immediately halving the cost. As the table below shows, the smaller mulch still has the effect of increasing the yield of cotton considerably. This increase more than counter-balances the cost of mulching.

TABLE IV.

Treatment.	Yield of seed cotton. Lbs per acre.	% fifi.	Gross returns from cotton @ 12/50 and 4/- per 100 lbs.	Cost of mulching. per acre.	Cost of weeding. per acre.	Cash return less cost of mulching and cost of weeding. per acre.
			Shs. cts.	Shs. cts.	Shs. cts.	Shs. cts.
Control ...	893	14·6	100 66	...	22 26	78 40
Mulch ...	1,282	12·6	146 48	30 69	13 35	102 44
Least Significant Difference ...	129	1·5	...	...	...	...

This shows a net increase in profit due to mulching of Shs. 24/04 per acre without taking into account any residual value of the mulch. This residual value is being ascertained by a groundnut crop followed by a cotton crop next season.

The difference in percentage " fifi " cotton is significant and mulching appears to reduce " fifi " by 2%, no doubt in some large part due to prevention of rain splashing. The lower cost of weeding in the mulched plots is noteworthy.

(*f*) *Green Manure Experiment.*—This experiment was started this season with the object of finding out if the action of green manure on the subsequent cotton crop is dependent on the length of time that it is dug in before the cotton is planted. Four periods were chosen—2, 4, 6 and 8 weeks before planting the cotton, and in order to ensure that the green manure (*Crotalaria juncea*) was as near as possible at the same stage of growth at each time of digging-in it was sown at corresponding dates; the period between sowing the green manure and digging-in being approximately six weeks.

The results were as follows :—

TABLE V.

Period between digging-in and planting cotton.	Yield per acre seed cotton. lbs.	Percentage fifi.	Percentage germination (original).
Control	1,064	12·7	55·6
2 weeks	1,008	14·2	59·0
4 weeks	1,224	13·4	62·6
6 weeks	1,120	12·9	52·6
8 weeks	1,064	12·1	40·6
Least Significant Difference	104	...	3·4

Digging-in *four weeks* prior to planting has given an increase over *Control* and over all the other treatments. Digging-in *six weeks* before planting is better than *two weeks*. This is the first record at Bukalasa of a green manure causing a significant increase in yield in the subsequent cotton crop.

A further interesting point arose in this experiment with regard to germination : plots with the earliest digging-in gave significantly worse germination than any other treatment. The two weeks period gave a better germination than six weeks, while four weeks was better than all.

3. INCREASE.—The new land was planted for the first time ; the 16 acres for cotton increase being divided into three plots, one of four acres and the other two of six acres which were planted in June, July and August respectively with S.G. 23/8 cotton. The yields obtained, tabulated below, are rather disappointing, but this land has been under native cultivation for some considerable period previous to purchase by the department, and house compounds occupied quite a large proportion of the area, so that it cannot be expected to be in too good a condition.

TABLE VI.

Sowing Date.	Area (acres).	Yield per acre. lbs.	Percentage fifi.
June	4	557	11·7
July	6	477	9·4
August	6	447	10·0

Groundnuts.

1. VARIETY TRIAL.—Six varieties were included in this experiment, three of them—African Bunch, Tanganyika Bunch, and Virginia Bunch (Serere)—having been obtained from Serere.

The spacing adopted was 1 ft. by 1 ft. and satisfactory yields were obtained.

TABLE VII.

Variety.	Yield per acre (unshelled).	Shelling percentage.	Yield per acre (shelled).
Virginia Bunch (Bukalasa) ...	2,144	58·5	1,259
Bukalasa Bunch	1,960	58·0	1,140
Tanganyika Bunch	1,789	53·8	967
African Bunch	1,780	42·0	750
Philippine Pink	1,260	49·0	619
Virginia Bunch (Serere) ...	1,175	58·5	685
Least Significant Difference ...	219	...	148

The unshelled figures show Virginia Bunch (Bukalasa) to be significantly better than all the others except Bukalasa Bunch. All varieties give significantly higher yields than either Philippine Pink or Virginia Bunch (Serere), between which there is no difference.

The shelling percentages vary considerably and the Virginia Bunch types are much superior to the others in this respect. The shelled yields give the same significant results as the unshelled except that African Bunch is no longer significantly better than either Philippine Pink or Virginia Bunch (Serere).

2. Spacing and Mulching.—This experiment was continued as in the previous year with slight modifications, a closer spacing of 1 ft. by 6 ins. being included for the first time.

Rosette counts were made but the incidence of rosette in the early sown groundnut crop was so slight that the figures obtained afforded no evidence of variation in percentage infection due to any of the treatments.

The following results were obtained :—

Table VIII.

Treatment.	Yield per acre (shelled).
	lbs.
2 ft. by 2 ft.	490
2 ft. by 2 ft. (mulched)	625
1 ft. by 1 ft.	1,100
1 ft. by ½ ft.	1,390
Least Significant Difference	440

The results are similar to those of last year. Mulching has no effect on yield and the closer spacing gives a considerable increase over wide spacing. At the same time the 1 ft. by 6 ins. spacing gives no significant increase over 1 ft. by 1 ft.

4. Increase Plots.—Increase plots of all varieties were grown and seed was supplied to Mukono Lukiko farm ; the Agricultural Officer, West Nile ; and the Agricultural Officer, Masaka.

Coffee.

1. The Shade and Ground Treatment Experiment on G.1.—This yielded a comparatively poor crop this season but the new flowering promises a bumper crop next year. The treatments remained the same as before but many coffee bushes had to be stumped, especially in the unshaded plots. Satisfactory growth followed the stumping and in no cases have the trees died off. As in the previous season, half the shade trees were heavily cut back to reduce the shade which was becoming too dense. It is becoming increasingly difficult to maintain the plantains in the "plantain shade" plots which bears out the local statement that in time coffee will kill out the plantains in which it is planted.

The yield figures for the season are given below :—

Table IX.—Mean Yield (lbs. per plot, wet cherry). (Plots 1/6 acre in area).

Treatment.	No Shade.	Plantain Shade.	*Gliricidia* Shade.	Mean.
Clean weeded	687	724	680	697
Permanent cover	554	554	639	582
Mean	621	639	659	...

The least significant difference is 92·5 lbs., which puts the No Shade and Plantain Shade clean-weeded plots as better yielding than those under Permanent Cover.

In the case of the *Gliricidia* Shade, however, there is no difference between clean-weeding and the cover crop. The total yields to date from this experiment are tabulated below.

Table X.—Mean Total Yield (in lbs. wet cherry) per Plot (1/6 acre).

Treatment.	No shade.	Plantain Shade.	Gliricidia Shade.	Mean.
Clean weeding	2,735	2,585	2,311	2,544
Permanent cover	2,241	1,902	2,189	2,111
Mean	2,488	2,244	2,250	2,327

(2) THE GROUND TREATMENT EXPERIMENT ON K.2.—This yielded for the first time this season. The increases in yields of the mulched and clean-weeded plots over the other two treatments are significant. This experiment forms a very good example to all coffee cultivators of the folly of allowing weeds to grow amongst coffee; the weed cover plots stand out as the poorest of all treatments.

TABLE XI.—MEAN YIELD IN LBS. WET CHERRY PER PLOT.

Treatment.	Yield.
Clean weeding	381
Elephant grass mulch	394
Permanent cover	121
Weed cover	101
Least Significant Difference	91

(3) The second GROUND TREATMENT AND SHADE EXPERIMENT was planted on N.2 this year. The following treatments are included :—

No shade ...	...	Clean weeding	...	Cotton seed as manure.
		Temporary cover crop ...		
		Full elephant grass mulch ...		
Shade ...		Alternate row grass mulch ...		No Cotton seed.

There are also eight selections included in the experiment, one row of each being planted at random in each plot.

Plantains.

The plantain gardens have been maintained and special efforts have been made to keep them free from banana weevil. Trapping has proved very successful and over 2,859 adult weevils were trapped in less than two months from a 1½-acre garden.

Cassava.

The collection of varieties has been maintained and added to by several local types. Special observations on Mosaic disease are being carried out.

Other Experiments.

1. COTTON MANURIAL.—The experiment to test the value of cotton seed and/or green manure as manures for a groundnut/cotton rotation was continued. Last year's results shewed clearly the beneficial effect of cotton seed. This year the residual value was tested first with a groundnut crop and afterwards with cotton.

The groundnuts gave significant results showing that the residual value of cotton seed up to that period was considerable. The cotton figures, however, are not significant although they indicate a further increase due to the original cotton seed. It is noteworthy that the residual effect of green manure was nil.

TABLE XII.

Treatment.	Mean yield of groundnuts per acre (unshelled).	Mean yield of cotton per acre.
	lbs.	*lbs.*
Control	1,998	1,275
Cotton seed	2,621	1,505
Green manure	1,951	1,330
Cotton seed plus green manure	2,166	1,435
Least Significant Difference	240	...

2. TOBACCO ROTATION.—The first tobacco crop was taken off this experiment and the following table gives the mean yields per acre of cured tobacco obtained :—

TABLE XIII.

	lbs.
Rotation A.	297
„ B.	Not grown.
„ C.	231
„ D.	297

Model Shamba.

The Model Shamba was carried on most successfully by the same tenant. The yields obtained were the highest yet recorded for simsim and groundnuts while cotton gave the third highest yield. The signs of deterioration which appeared to be present last year have disappeared. The following shows the income for the season :—

						Shs.	*cts.*
Cotton Safi	...	...	793 lbs.	@	13 cents	—	103	09
„ Fifi	...	...	56 lbs.	@	4½ cents	—	2	52
Maize	...	...	1,032 lbs.	@	1 cent	—	10	32
Groundnuts	...	...	515 lbs.	@	6 cents	—	30	90
Simsim	...	...	92 lbs.	@	4 cents	—	3	68
					Gross income		150	51
Less 36 man-days labour employed				@	33 cents	...	11	88
					Net Income		138	63

The result is highly satisfactory and it is the second highest profit that has yet been made. (Simsim and groundnuts kept for seed are not included in the above statement).

The following table shows the yields and profits for the holding since it was started in 1927.

TABLE XIV.

Year.	Yield of cotton per acre.	Yield of groundnuts per acre.	Yield of simsim per acre.	Net Profit.	Acreage under economic crops.
	lbs.	*lbs.*	*lbs.*	*Shs.* *cts.*	
1927-28	?	?	188	55 78	2
1928-29	615	60	174	149 20	2
1929-30	608	102	90	115 18	1⅓
1930-31	380	1,035	189	122 29	1⅓
1931-32	200	378	135	101 57	1⅓
1932-33	414	338	80	104 27	2
1933-34	305	*726	48	85 93	2
1934-35	566	*1,090	204	138 63	2
Average ...	441	533	138	109 11	1¾

*Closer spacing of groundnuts was adopted in 1933.

Miscellaneous Crops.

Stocks were maintained of all useful cover crops and green manures. New crops tried for the first time were Tepary Bean, *Coronilla varia*, *Tephrosia candida*, *Clitoria*, *Abroma*, etc. A small plot of tea was planted in the early rains as a seed garden, the growth has been very slow indeed and a number of trees have died off.

Compost.

All refuse on the plantation is being composted and a large amount of material is produced for application to non-experimental plots.

Visitors.

Among the visitors to the plantation during the year were the Empire Parliament Delegates and the Experimental Sub-Committee of the Coffee Board.

Numerous parties of chiefs and school children were shown round the Plantation.

D. STEDMAN DAVIES,
Acting Senior Agricultural Officer.

G. W. NYE,
Senior Botanist.

REPORT OF THE BOTANICAL SECTION, 1934-1935.

The report is divided into Parts as follows:—

PART I.—Introduction.
,, II.—Botanical Work at Bukalasa.
,, III.—Botanical Work at Serere.
,, IV.—Botanical Work at Kampala.
,, V.—Botanical Gardens, Entebbe.

PART I.—INTRODUCTION.

Staff.

The Senior Botanist was stationed at Bukalasa throughout the period under review. The work at Serere was carried on by Mr. Jameson until the Assistant Botanist returned from leave in October. The Botanical work in Kampala was carried on by Mr. Chandler during the absence on leave of the Assistant Botanist from May until November. Mr. Chandler has been in charge of the Botanical Gardens at Entebbe for the whole period.

Cotton.

The weather conditions throughout the country were dry and generally abnormal and the result was a reduction in the yield per acre of cotton. Blackarm developed to a greater extent at Bukalasa and in the surrounding area than has hitherto been reported but the plants appeared to recover from the attack. The very early plantings at Serere were not so successful as usual but at Bukalasa indications again occurred to show that early plantings in Buganda usually produce a good crop. For Bukalasa and the surrounding area the optimum sowing dates would appear to be between May 20th and June 7th and between June 30th and July 15th.

The cotton breeding results of the season under review are more encouraging than they have been for several years. In the first place, a U. 4/4/2 derivative—S.P. 87—selected at Serere has given lint of a quality superior to that of S.G. 29 combined with the promise of a greatly increased yield. This strain—S.P. 87—is to be increased as rapidly as possible with a view to ultimate distribution should the Broker's and Spinning reports be satisfactory. At Bukalasa, too, we are able to record the successful performance of a new strain—B.P. 50—originally selected from local cotton. Its yield is equal to that of Local, its Ginning Outturn better while its lint is considerably longer, stronger and more uniform than Local.

S.G. 23/8 has maintained its high spinning performance and has kept remarkably uniform.

With regard to Blackarm resistance—at Serere U. 4/4/2 derivatives including S.P. 87 are highly resistant to this disease and it can be confidently stated that when one of these superior strains can be put into general cultivation a very large proportion of the annual loss due to Blackarm will be saved. S.G. 29 suffered badly from Blackarm and in most respects showed considerable deterioration.

Disease resistance at Bukalasa is complicated by the growing importance of Wilt. High resistance to Blackarm was shown by B.P. 50 and S.G. 23/8 derivatives and no wilt has yet been observed in S.G. 23/8.

The general superiority in yield of U. 4/4/2 derivatives at Serere as compared with the Nyasaland types has been fully maintained.

Coffee.

The work of Selection and of Observation on promising trees of Robusta has continued.

It is satisfactory to note the success obtained in self-fertilisation of Robusta and further work on this subject will be carried on.

Investigations into the vegetative reproduction of coffee have been continued and limited success has been obtained from cuttings.

It is disappointing to report the dying off of a number of the grafts due possibly to incompatibility of stock and Scion.

The results obtained so far in the soil treatment and growth experiment are very interesting in showing the value of mulch and shade in controlling soil temperatures.

Tea.

The increasing importance of tea in Uganda has been reflected in the attention given to the production of seed. The planting out of new Jats at various centres has been done although conditions experienced last year somewhat militated against a good stand being obtained.

Groundnuts.

The increase in yield of bunch types at Serere as compared with spreading type is noteworthy. It is understood that the natives prefer the spreading type on account of the damage done by locusts to the bunch types. Selection has proceeded at Serere and one promising strain, 235, has been obtained.

Other Crops.

Work on sim-sim, tobacco, ginger, cover crops, shea nuts, castor oil, essential oils and fibres, etc., has continued and notes on progress are given in the various reports.

Acknowledgment.

The Liverpool Uganda Co. and Messrs. Narandhas Rajaram and Co., have rendered valuable assistance in examining numerous lint samples from Serere and Bukalasa and the opportunity is taken to acknowledge gratefully their assistance.

G. W. NYE,
Senior Botanist.

PART II.—BOTANICAL WORK AT BUKALASA.

Meteorology.

The first rains were much later in breaking than usual and heavy rains did not occur until the end of May. June was very dry only 1·66 inches falling during the month. July also, although having a total above the average, was seriously dry and cotton planting was only possible on four days during the month. Later in the year the rains were normal but the picking period January to March was abnormally dry which accounts for the good crop obtained at Bukalasa. The dry periods were not always periods of heat; in fact, cold misty days were the rule in July and these conditions caused very heavy primary infections of Angular Leaf Spot, especially on the early sown crop.

No hail was experienced this season but the conditions in the "Autumn" rainy period were adverse to the late sown tobacco which produced practically no crop at all. Leaf curl and Mosaic were widespread, more especially amongst the Burley tobaccos.

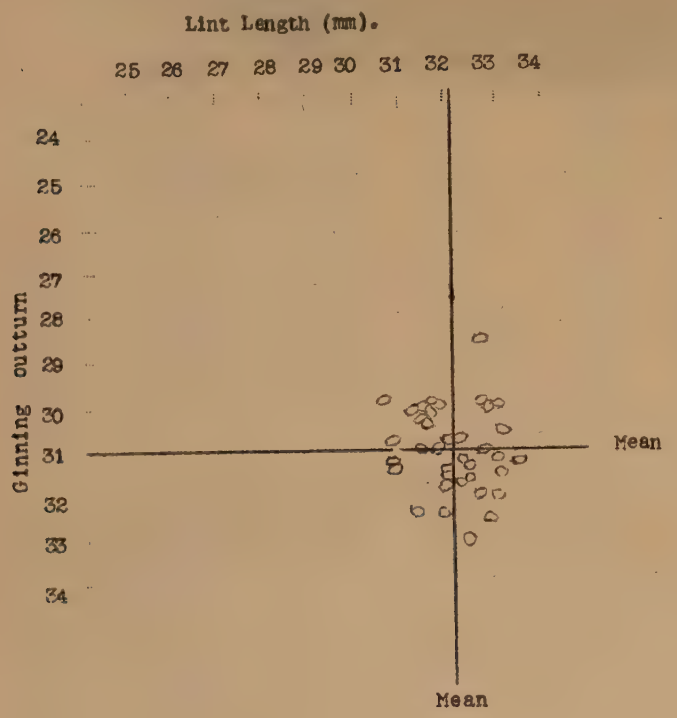
The dry picking season resulted in a low percentage of "fifi" cotton but it increased the amount of immature lint. The dry "development" periods resulted in a very mixed staple which was general throughout the Protectorate.

The following table summarises the meteorological position of the period under review:—

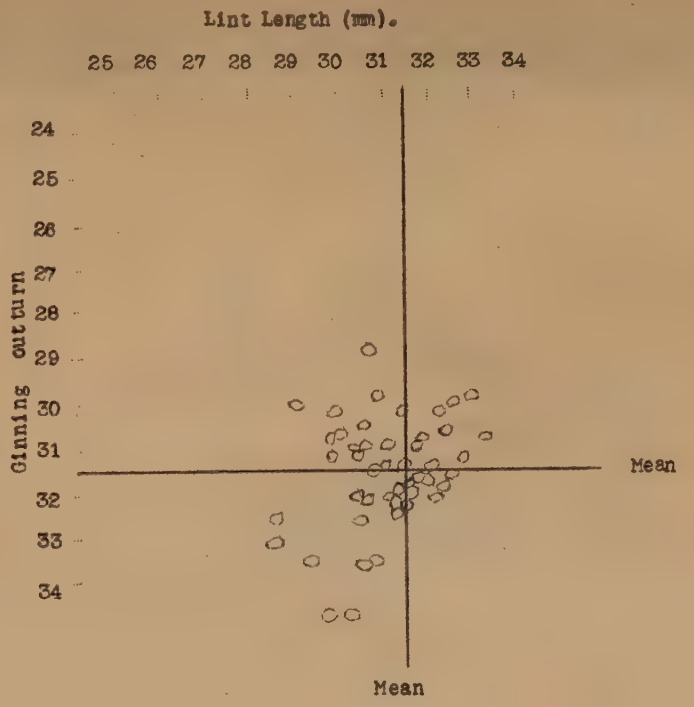
Month.	Rainfall. ins.	Highest fall in one day.	Deviation from 11-year mean.	Daily Sunshine. hours.	Remarks.
1934.					
April ...	6·75	1·65	— 0·02	5·5	Rains did not break until 12th.
May ...	7·49	2·34	+ 2·59	5·7	4·15" of the total fell on two days at the end of the month.
June ...	1·66	0·60	— 1·93	5·3	Very dry.
July ...	3·93	2·32	— 0·16	3·9	Cool and misty but very little rain.
August ...	6·29	1·66	— 1·60	5·1	Rains well distributed throughout month.
September ...	4·07	0·97	— 1·02	5·3	Very dry spell from 3rd to 23rd.
October ...	7·86	2·34	— 0·71	6·2	Very humid, Blackarm developed rapidly.
November ...	2·13	0·85	— 2·19	5·2	Very dry.
December ...	3·45	0·74	— 0·44	6·7	
1935.					
January ...	0·75	0·66	— 0·77	8·6	
February ...	2·49	0·70	— 0·18	4·9	
March ...	3·57	1·45	— 1·24	7·3	

PURITY TARGETS.

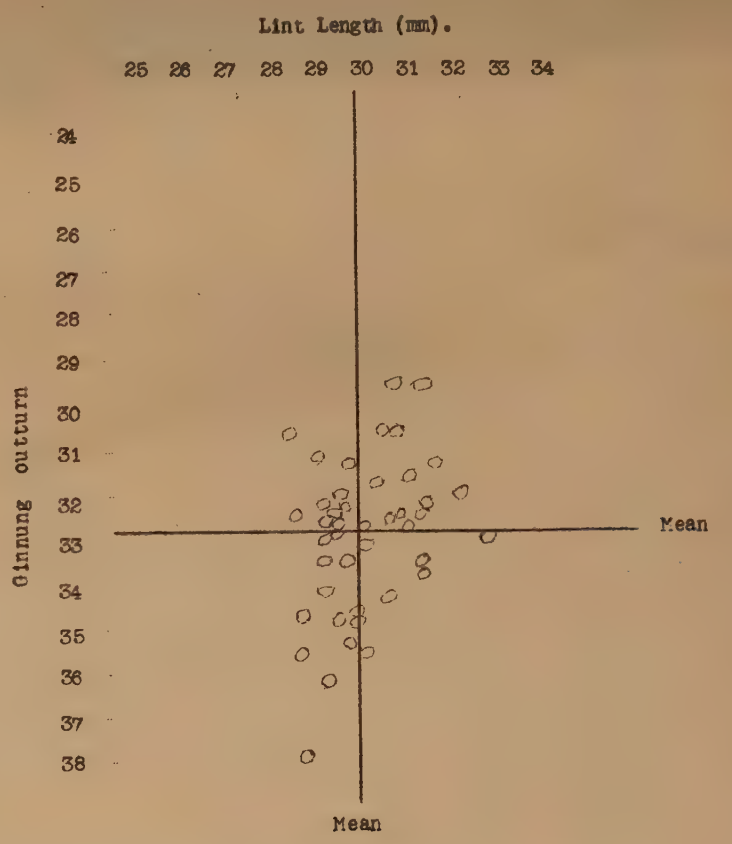
B.P. 79



B.P. 89



B.P. 96



The above are purity targets of three of the Pedigree Lines. Each dot represents a single plant. The uniformity of B.P. 79 as compared with the other two, is noteworthy. B.P. 79 is a child of B.P. 50 and has a much better target than B.P. 50 had in the previous Season. B.P. 89 is probably still splitting for both characters while B.P. 96 appears to be splitting for ginning outturn.

Cotton.

I. BREEDING PLOT.

Some really promising material was obtained this year from selections which had been made in local cotton in Bulemezi. B. 180—a very distinct type promises well—it appears to be highly resistant to Blackarm, gives a good yield of fairly good quality lint and is uniform. B. 181 was also promising but split for lint characters—several re-selections have been made for further work next season. B. 274 was a strain selected by Mr. Fishlock in Buruli; its habit was very erect all the monopodia growing vertically; unfortunately it was very susceptible to Blackarm. Re-selections from B. 31 were disappointing and none of them showed the high resistance to Blackarm of the original parent.

Several U. 4/4/2 derivatives were grown but only one of these had lint of a satisfactory quality. Two new U. 4 strains from South Africa, U. 955 and U. 998, were grown for the first time but they showed little promise as their staple was very short indeed.

Pedigree Lines.—

The number of Pedigree Lines grown in the season under review was in excess of the usual number owing to the gradual increase in promising strains.

The Lines of this season fall into two main groups:—

(I) The B. 37 (or B.P. 50) group, and

(II) The S.G. 23/8 group.

The Lines in the B.P. 50 group showed considerable improvement over B.P. 50 with regard to uniformity, but apart from that their lint characters were no better. Strong evidence of splitting for Blackarm susceptibility was obtained and several lines were scrapped on this account, those retained show considerable improvement over B.P. 50 in this respect. B.P. 75 appeared to be susceptible to wilt, as 30% of the plants had to be uprooted on account of this disease. The most promising of the group was B.P. 79 which will be put into increase next season.

The S.G. 23/8 group was interesting—the boll shedding rates of most of the group were the lowest we have yet recorded in this country and in three of the lines the low shedding appeared definitely to be correlated with high yield, which is not the case with the original S.G. 23/8. Other characters are not so promising except that resistance to Blackarm appeared to be considerably greater than in S.G. 23/8. Either the ginning outturn is too low or the staple too short—a satisfactory combination of the two did not occur except in B.P. 103 which unfortunately had a higher boll shedding rate than the others. Further re-selection and crossing may produce a satisfactory combination.

A Pedigree—B.P. 89 (originally from B. 42 a local selection and directly from B.P. 52) yielded very well despite a severe attack of Blackarm; as will be seen in the table below it was attacked by Blackarm to a much greater extent than any other line. Its lint characters are very promising.

Three U. 4/4/2 derivatives were included and yielded very well indeed, especially S.P. 56, their lint characters, however, were disappointing and they are still far below the standard in this respect.

The following table summarises the quantitative characters of the most promising lines:—

TABLE II.

Group.	Line.	Mean flowers per plant.	Mean bolls per plant.	Shedding %age.	Mean Blackarm Lesions per plant.	Lint Length. mm.	Ginning Outturn.
B.P. 50 (B. 37)	B.P. 75	54	22·2	58·8	1·27	32·9	29·3
	B.P. 76	46	20·9	54·6	3·18	33·0	29·4
	B.P. 79	51·5	20·0	61·0	2·00	32·1	31·0
B.P. 52 (B. 42)	B.P. 89	81·5	30·3	63·0	10·48	31·5	31·6
B. 45	B.P. 94	41·7	20·4	51·0	5·90	29·4	30·1
S.G. 23/8	B.P. 96	51·9	33·7	35·0	1·54	29·7	30·3
	B.P. 98	54	35·3	35·7	1·02	29·4	31·2
	B.P. 100	47·5	31·6	33·5	0·83	29·4	30·0
	B.P. 102	48·5	29·6	38·9	1·08	28·8	31·9
	B.P. 103	41·6	23·2	44·3	1·50	30·4	30·3
	B.P. 104	43·3	29·2	32·5	0·50	30·5	28·0
U. 4/4/2	S.P. 39	81	32·8	59·6	0·20	28·7	...
	S.P. 43	83	36·1	61·3	0·47	28·6	...
	S.P. 56	...	40·7	...	0·32	28·0	34·8

Reference Plot.—

As usual a collection of imported varieties was maintained. Amongst these Ishan A from Nigeria gave an outstanding yield although the Lint was short and distinctly harsh.

Crossing Work.—

A start was made with crossing as it appears unlikely that we shall obtain success in selecting out an ideal combination of yield, quality and disease resistance. The number of successful takes was not very satisfactory and only 11 F1's are available for next season's planting.

Wilt Plot.—

In view of the serious spread of Wilt disease in Buganda work on breeding for resistance has been taken in hand. A $\frac{1}{8}$-acre plot consisting of a mixture of all strains and varieties available, was planted in a plot which had been infected with wilt by means of digging in infected material Any plants showing wilt were dug in and approximately 10% of the plot was attacked. A further 10% had wilt without external symptoms; examination of the stems showing typical discoloration at the time of uprooting.

The seed obtained from this plot will be planted on the same plot next year the object being to obtain resistant strains by "controlled" natural selection.

Field Selections.—

About 60 selections were made in the field during the season and the majority of these will be included in next years new selection series.

Trinidad Hybrids.—

Selections made in the previous year were grown. The results, however, are not yet available owing to the mass of material still awaiting analysis.

II. INCREASE.

Small Bulk.—

The $\frac{1}{4}$-acre increase plot was planted with B.P. 58, a re-selection from S.G. 23/8. Early sown it yielded exactly 1,000 lbs. seed cotton per acre on the worst land on the Plantation. In the variety trial it gave the highest yield. Unfortunately its lint is rather short and harsh, in fact very similar to the U. 4 type. Local lint buyers place it much below S.G. 23/8.

Medium Bulk.—

One and one-third acres were planted with B.P. 50, a derivative of B. 37. Shortage of seed gave a poor stand and the removal of 25% of the plants in rogueing for Blackarm, gave a final stand of about 50% of the optimum. A yield of 780 lbs. per acre was under the circumstances very satisfactory. The crop was ginned commercially and gave a ginning percentage of 31·6%. Its length is full 1 3/16th and it is probably the best quality cotton we have in Buganda. This increase plot was remarkably uniform for habit, which is very erect—rather similar in this respect to some of the U. 4 strains. This strain will be bulk increased at Bukalasa next season.

Main Bulk.—

16 acres were planted with S.G. 23/8 in order to obtain a bulk of lint for commercial tests. This was planted on the new land at Bukalasa and averaged just 500 lbs. per acre. A small area was reserved for selfing.

Variety Trials.

A. BUKALASA.

This was in the form of a 8 by 8 Latin square with plots 1/40th acre in area. The standard spacing of 4 ft. by 1½ ft. was used.

The following varieties were included:—

Local (Control).
S.G. 23/8 (Nyasaland upland selection made at Serere in 1924).
B.P. 49 (B. 31 derivative—Local selection).
B.P. 50 (B. 37 derivative—Local selection).
B.P. 52 (B. 42 derivative—Local selection).
B.P. 56 (B. 45 derivative—Local selection).
B.P. 58 (S.G. 23/8 derivative).
B.P. 59 (S.G. 23/8 derivative).

Germination.—This was excellent and no varietal differences were observed.

Habit.—The strain B.P. 50 was generally erect and the lower branches well clear of the ground. B.P. 52 was also erect and B.P. 56 tall and single stem type which makes for early maturity. B. 49 was very squat and there was little difference between the members of the 23/8 group, two of them had slightly more erect habits than Local while B.P. 59 had the worst habit of the lot.

Blackarm.—Routine counts of Angular Leaf Spot and Blackarm were carried on weekly but the most valuable results are those from an examination made by the Mycologist in December.

The table below summaries these results:—

TABLE III.

	Variety.	Mean number of Blackarm Lesions per plant, December.	Angular Leaf Spot count in October.
1.	Local ...	2·71	81·5
	B.P. 56 ...	3·48	155·3
2.	B.P. 59 ...	3·54	129·0
	S.G. 23/8 ...	3·87	144·4
	B.P. 50 ...	3·90	114·1
3.	B.P. 58 ...	3·95	73·1
	B.P. 49 ...	5·40	20·1
4.	B.P. 52 ...	6·48	149·0
	Least Significant Difference ...	1·04	64·7

Local has significantly less Blackarm than any of groups 3 and 4 while groups 2 and 3 have significantly less than those of group 4. Only group 4 can be considered to be seriously attacked and of the two varieties in this group B.P. 49 gave the lowest yield while B.P. 52 came comparatively high in the list.

Lygus.—Lygus attack was very severe indeed in October but a complete recovery was made although a single stem variety such as B.P. 56 naturally suffered considerably more than the other varieties. Although counts were made in October by the Entomologist no varietal differences were apparent.

Maturity.—The question of early maturity is of importance in connection with Pink Bollworm control and considerable variation in the dates of the picking peaks occurred in the trial.

TABLE IV.

Variety.	Date of Picking Peak.	Date by which 50% of total crop was harvested.
B.P. 56	16th January ...	16th January.
B.P. 52	do do ...	23rd January.
B.P. 50	do do ...	30th January.
B.P. 58	23rd January ...	30th January.
B.P. 59	do do ...	6th February.
S.G. 23/8	do do ...	6th February.
Local	13th February ...	6th February.
B.P. 49	do do ...	

Yield.—The yields are summarised in the table below. The Ginning Outturns were worked out from commercially ginned samples.

TABLE V. (Figures in lbs. per acre).

Variety.	Total Yield Seed Cotton. lbs. per acre.	%age stained Cotton (Fifi).	Ginning percentage.	Total Yield Lint. lbs. per acre.	Cash Value of Crop (Seed Cotton) per acre.	Lint Length mm. (pulled tuft).
					Shs.	
B.P. 58 ...	1,524	8·9	30·0	456	172	...
B.P. 50 ...	1,476	9·2	30·7	456	166	31·0
Local ...	1,476	9·9	30·4	448	165	27·6
B.P. 52 ...	1,420	10·7	29·9	428	159	31·5
B.P. 59 ...	1,436	9·1	28·5	408	162	29·9
S.G. 23/8 ...	1,348	9·2	31·6	424	152	29·4
B.P. 56 ...	1,256	12·9	30·7	384	138	...
B.P. 49 ...	896	12·6	29·6	264	99	...
Least Significant Difference ...	126·4	1·44	...	38·4	...	...

The Total Seed Cotton results show all varieties to yield better than B.P. 49. B.P. 58, B.P. 50 and Local, between which there is no difference, are higher yielders than S.G. 23/8 and B.P. 56. B.P. 52 and B.P. 59 are also higher yielders than B.P. 56.

The most interesting result is that one of the S.G. 23/8 derivatives (B.P. 58) has yielded more than the parent. With regard to the lint figures the results are practically similar but the better Ginning Outturn of S.G. 23/8 has put it up level with Local and B.P. 50.

The "Fifi" percentages show the superiority of S.G. 23/8 and its derivatives, Local and B.P. 50, over the remainder.

With regard to quality of lint, samples have been submitted to local lint buyers who are unanimous in putting B.P. 50 easily head of the list with B.P. 52 second, and S.G. 23/8 third. B.P. 50 is long stapled, silky and strong and uniform and represents a considerable advance over ordinary local.

DISTRICT VARIETY TRIALS.

Variety Trials were conducted at the following centres:—

Mengo District	Kalagala.
	Makurubita.
	Nakifuma.
	Mukono.
Entebbe District	Kitala.
	Kabasanda.
	Nkozi.
Masaka District	Kyanamukaka.

In addition, four trials were conducted in Busoga district at the same centres as the "Serere" trials. The Nakifuma trial was completely destroyed by hail in September and the Kabasanda results are worthless on account of mixed picking by the native in charge.

The results from the other trials are summarised below:—

TABLE VI.—YIELD OF SEED COTTON IN LBS. PER ACRE.

Centre.	Local.	S.G. 23/8.	B.P. 50 (parent) of.	B. 31.	Least Significant Difference.
Mukono	1,400	1,088	1,168	...	...
Makurubita	792	728	800	...	...
Kalagala	1,072	968	...	...	...
Bukalasa	1,476	1,348	1,476	...	...
Kitala (Entebbe)	920	704	1,160	...	...
Kabasanda	464	472	...	...	...
Nkozi	760	648	760	...	...
Kyanamukaka	868	848	...	872	...

Although at no single centre are the results significant yet an analysis of the combined results shows that Local cotton has given a significantly higher yield of *total Seed Cotton* than S.G. 23/8. The higher ginning percentage of S.G. 23/8, however, brings it yield of *lint* practically equal to that of Local.

TABLE VII.—LINT LENGTH. (mm.).

Centre.	Local.	S.G. 23/8.	B.P. 50 (parent).
Kitala	27·9	29·5	31·4
Nkozi	29·2	30·2	31·6
Makurubita	27·4	28·4	31·0
Mean	28·2	29·4	31·3

At most of the above centres Blackarm lesion counts were made by the Mycologist, the results being tabulated below.

TABLE VIII.—NUMBER OF BLACKARM LESIONS PER PLANT.

Centre.	Local.	S.G. 23/8.	B.P. 50.	B. 31.	Mean.	Least Significant Difference.
Mukono	1·47	1·59	1·40	...	1·48	Nil
Kalagala	1·19	1·47	...	...	1·33	...
Makurubita	0·43	0·64	0·74	...	0·60	Nil
Nkozi	0·92	0·50	0·92	...	0·78	Nil
Kabasanda	0·35	0·69	...	...	0·52	0·12
Entebbe	0·59	0·54	...	...	0·57	...
Kyanamukaka	0·04	0·09	...	0·04	0·06	...
Bukalasa	2·71	3·87	3·90	...	3·49	1·04

The differences in intensity of attack are very marked—Bukalasa being easily the highest with Kyanamukaka at the other end of the scale. The results are significant only at two centres—Kabasanda and Bukalasa where S.G. 23/8 gives more lesions per plant than Local.

Busoga Trials.

The results of these are summarised in the table below:—

TABLE IX.—TOTAL SEED COTTON (lbs. per acre).

Centre.	B. 31.	S.G. 23/8.	S.G. 29	Buganda Local.	Mean.	Least Significant Difference.
Wanyange	988	858	871	884	900	...
Bulopa	390	429	273	455	387	...
Bugaya	182	234	169	241	208	...
Vukula	715	559	598	559	608	262
Mean	568	520	478	545	...	...

There is a certain amount of interaction between centre and variety but the outstanding result is B. 31 has generally done better in Busoga than the other varieties, whereas it and its derivatives have never done well at Bukalasa. In fact on a combined analysis B. 31 has given significantly higher yields than either S.G. 23/8 or S.G. 29. In the analysis of Lint yields as compared with Total Seed Cotton yields there are no differences between the varieties due to the fact that both Local Buganda and S.G. 23/8 have higher ginning outurn than B. 31.

The Mycologist examined all these trials for Blackarm lesion and his results are given below.

TABLE X.—BLACKARM LESIONS PER PLANT.

Centre.	B. 31.	S.G. 23/8.	S.G. 29	Buganda Local.	Least Signficant Difference.
Vukula	2·50	2·37	5·58	3·01	2·25
Bugaya	0·58	0·71	0·91	0·66	...
Bulopa	0·41	1·01	0·98	0·63	...
Wanyange	0·54	0·55	0·78	0·67	...
Means	1·00	1·15	2·06	1·24	0·50

Thus it is seen that S.G. 29 has significantly more Blackarm than the other varieties between which there are no differences. Vukulu stands out as being a centre of high infection as compared with the other centres.

Spinning Tests and Brokers' Reports, 1933-34 Crop.

We are indebted to Messrs. Wolstenholme & Holland for the following reports on samples of Lint submitted from the Western area:—

TABLE XI.

Variety.	Where Grown.	Staple.	Strength.	Valuation (Based on American middling 6·89).
S.G. 23/8	Bukalasa ...	1⅛ ins. ...	Strong ...	7·49
B.P. 28	do ...	Full 1⅛ ins. ...	Medium strong...	7·69
B. 31	do ...	Full 1⅛ ins. ...	Strong ...	7·79
Local	do ...	Good 1⅛ ins. ...	Strong ...	7·59
S.G. 23/8 ...	Nakifuma ...	Full 1⅛ ins. wasty	Strong ...	7·64
Local	do ...	Full 1⅛ ins. ...	Strong ...	7·79

It will be noticed that those varieties from Bukalasa with the highest valuations, *i.e.*, B. 31 and B.P. 28, are those which gave the poorest spining tests.

TABLE XII.—SUMMARY OF SPINNING TESTS.

Sample.	Actual Count.	Lea Strength.	Count Strength product.	Count work of rupture product.	Highest Standard Count.
50's.					
S.G. 23/8 (Bukalasa) ...	49·7	49·6	2,465	2,870	85—87
B.P. 28 „ ...	50·7	41·4	2,099	2,802	56—58
B. 31 „ ...	49·6	36·8	1,825	2,144	39—41
Local „ ...	51·0	39·1	1,994	2,395	49—51
S.G. 23/8 (Nakifuma) ...	50·7	46·2	2,342	2,870	68—70
Local „ ...	50·6	38·0	1,923	2,442	44—46
64's.					
S.G. 23/8 (Bukalasa) ...	61·0	37·5	2,288	2,679	...
B.P. 28 „ ...	62·5	30·2	1,888	2,714	...
B. 31 „ ...	64·5	24·6	1,587	1,975	...
Local „ ...	63·7	28·7	1,828	2,302	...
S.G. 23/8 (Nakifuma) ...	65·7	31·8	2,089	2,412	...
Local „ ...	63·4	27·3	1,731	2,246	...

Thus the superiority of S.G. 23/8 is again very pronounced. The following extracts are taken from the spinning report:

"In strength the two samples of S.G. 23/8 are outstanding, the Bukalasa sample being rather stronger than the Nakifuma sample.

"B. 31 is the weakest sample while B.P. 28 is about equal to Local . . . the yarns from B. 31 are the poorest in appearance whilst those from B.P. 28 are also not good. The S.G. 23/8 and Local samples . . . are the best.

"It is clear that the superiority of S.G. 23/8 has been maintained, for the yarns spun from the variety are not only much stronger than those from Local but also at least as good in appearance. B. 31 is definitely poorer than Local in both strength and appearance; and B.P. 28 shows no marked superiority over Local in strength and is, if anything, inferior in appearance. There is nothing in the measured hair characters to account for the failure of B.P. 28 and B. 31 compared with S.G. 23/8, the only considerable difference lying in the immaturity of the samples, but this would not be expected to have such a marked effect on yarn strength as has actually been found."

TABLE XII.—MEASURABLE CHARACTERS.

Sample.	Mean Length. mm.	Effective Length (32nds in.).	% Short hairs.	% Normal hairs.	% Dead hairs.	Hair weight per cm. (10-5mgn.)
S.G. 23/8 (Bukalasa)	24·6	40	22	52	7	153
B.P. 28 (Bukalasa)	25·4	44	23	36	15	146
B. 31 (Bukalasa)	24·6	42	27	35	17	144
Local (Bukalasa)	24·6	41	24	40	15	160
S.G. 23/8 (Nakifuma)	24·6	40	23	53	13	155
Local (Nakifuma)	24·6	40	20	54	10	180

A series of samples was also examined by the Technological Laboratory of the Indian Central Cotton Committee. These confirm those from Shirley in demonstrating the superiority of S.G. 23/8.

The following table summarises the results:—

TABLE XIII.

Variety.	Grader's Report.		Fibre Particulars.	
	Staple Length. inches	Value Above Contract Rate (Basis Rs. 250).	Length (in.) Balls sorter.	Fibre weight per inch (millionth of ounce).
S.G. 23/8 (Nkozi) ...	1 3/32	Rs. 130 on	1·06	0·110
Local (Nkozi) ...	1 1/16	Rs. 125 on	1·06	0·132
S.G. 23/8 (Makurubita) ...	1 1/32	Rs. 120 on	1·03	0·106
Local (Makurubita) ...	1 1/32	Rs. 122 on	1·00	0·127
S.G. 23/8 (Bukalasa) ...	1 1/16	Rs. 125 on ... ... (Basis 245/-)	1·06	0·105
Local (Bukalasa) ...	1 1/16	Rs. 110 on ... ... (Basis 245/-)	1·07	0·117

TABLE XIV.—SPINNING TESTS.

Variety.	Actual Count.	Strength.	Count strength products.	Highest standard warp Count.
30's.				
S.G. 23/8 (Nkozi)	30·0	76·4	2,292	62
Local (Nkozi)	29·8	63·4	1,889	44
Local (Makurubita)	30·4	66·3	2,016	48
S.G. 23/8 (Bukalasa)	30·9	76·9	2,376	70
Local (Bukalasa)	31·1	66·1	2,056	50
50's.				
S.G. 23/8 (Nkozi)	48·6	38·2	1,857	...
Local (Nkozi)	48·7	32·3	1,573	...
23/8 (Makurubita)	50·2	34·0	1,707	54
Local (Makurubita)	49·2	32·6	1,604	...
S.G. 23/8 (Bukalasa)	49·6	40·0	1,984	...
Local (Bukalasa)	49·5	33·8	1,673	...

The following extract from the conclusions may be quoted: "Of the S.G. 23/8 cottons, that grown at Bukalasa gave the best test, that grown in Nkozi was second and Makurubita third . . . . Local cottons gave much poorer tests than the corresponding S.G. 23/8 samples, the difference being more marked in the case of the Bukalasa and Nkozi samples . . . . only four of these cottons were tested last year and among these the S.G. 23/8 (Nkozi and Bukalasa) samples show good improvement, the Nkozi Local gave practically the same performance while the Bukalasa (Local) shows a decline in its performance."

S.G. 23/8.

We are now in a position to say definitely that S.G. 23/8 is a much superior cotton from the Spinning point of view to Local. It is slightly inferior in yield of seed cotton as compared with Buganda Local but having a better ginning out-turn its yield of lint is practically similar. The observations of the Mycologist this season indicate that S.G. 23/8 is very little, if any, more susceptible to Blackarm than Local and so far there has been no sign whatsoever that it has been attacked by Jassids in Buganda although it has been grown in variety trials since 1930. No Wilt has yet been observed in this variety.

There is, however, the unfortunate fact that it is almost consistently marked down by the English broker as compared with Local which means a lower value. It is doubtful if the superior spinning value of the cotton would receive the recognition which it deserves on account of the fact that most Uganda cotton is used for mixing. This would probably mean that no financial benefit would accrue to Uganda from putting S.G. 23/8 into general distribution.

Seed Farm Areas.

During the season the question of the early stages of distribution of a new variety in the Western Area was carefully considered and a detailed survey was made of the Entebbe Peninsular. This area comprises one Gombolola and is eminently suitable for segregation as its only land boundary is less than a mile across. Estimations of the acreage were made and it was indicated that an area up to 600 acres might be expected to be planted with cotton in any one year. This is too big an area to be supplied from Bukalasa direct and the necessary link is the Kawanda Plantation recently taken over by Government. By careful supervision in the stages up to and including the Entebbe Peninsula there should be very little chance of vitiation and the new variety should be 95% as pure as when it leaves the medium bulk increase stage at Bukalasa. One Instructor is now permamently stationed in the Entebbe peninsula for propaganda purposes and for estimation of the cotton acreage.

Pests and Diseases.

Lygus.—This pest became very serious at one period at Bukalasa but later the plants attacked made a remarkable recovery. The attacks were localised, for example the variety trial was heavily infested whereas the Breeding Plot only 100 yards away was only comparatively slightly attacked.

Syagrus.—Very little damage by this pest occurred on the Plantation this season.

Pink Bollworm.—This appeared for the first time, specimens of the larvae being obtained from the late bolls. The infestation was not high.

Jassids.—No damage by Jassids was observed throughout the season.

Dysdercus spp.—An epidemic threatened on the May sown increase plot but hand picking completely checked the spread of the pest. Very few were observed elsewhere on the Plantation.

Spiny Bollworm.—This was present as usual and did considerable damage. The amount of damage done by this pest needs investigation as not only bolls of all sizes but terminal buds and flower buds are damaged in considerable numbers.

Helopeltis.—Practically no evidence of damage by this pest was observed.

Blackarm.—The incidence of this disease reached more serious proportions than the writer has previously observed in Buganda. Actually at Bukalasa it was not so serious as in the district, probably due to our drier conditions. Several resistant strains were observed in the breeding plot and it is satisfactory to report that derivatives of S.G. 23/8 and of B.P. 50 in the pedigree line stage show considerable improvement over their original parents in this respect.

Wilt.—Wilt disease was observed generally in Bulemezi but its incidence at Bukalasa was actually less than in the previous year except on the Breeding Plot where definitely infected patches appear to exist. So far no plant of S.G. 23/8 has been observed suffering from the disease.

Tobacco.

Further work on selection for disease resistance was carried on especially amongst the Air cured types such as the Burleys. The Burleys suffered very badly indeed from leaf curl in the Autumn sown crop and very little seed, or leaf for curing was obtained from them. Some of the Burley leaf obtained from the Spring sown crop was very well reported on. Apart from the Burleys one of the most promising types is Hickory Pryor which produces very large leaves and appears to be comparatively resistant to leaf curl.

Mosaic was serious for the first time at Bukalasa.

Sim-Sim.

Numerous field selections were made during this year and sufficient material has now been collected to enable proper breeding work to be carried on. Several importations from India have been tested and these are noticeably earlier maturing and lower yielding than local strains.

Ginger.

The growth of Ginger is very slow at Bukalasa and conditions are probably too dry for really economic cultivation. Tests are being carried out at Mukono in Kyagwe where the rainfall is considerably greater than that at Bukalasa.

Three types obtained from Ceylon were grown for the first time but only a few plants survived owing to extremely dry conditions after planting.

There are two distinct native types; one called "Kiboko" which has big leaves, and is said to yields better than the other which is known as "Nganda". Both types are being tested at Bukalasa.

Education.

The 4th Year Agricultural Course from Makerere has been at Bukalasa since the beginning of 1934. Instruction in farm practice and management, in laboratory work and in crop work was given.

The general interest shown by the students was encouraging and the standard of their various reports was high.

Local Propaganda.

It was felt that cultivators living in the vicinity of Bukalasa should show a higher standard of cultivation than those away from the station and during the year propaganda has been concentrated on the Gombolola Mutuba II in which Bukalasa is situated. Very valuable co-operation was given by the Gombolola Chief and a great deal of spade-work by means of visits to individuals was got through. A small team of cultivators who agreed to follow advice given was got together and this will form the nucleus for the spread of propaganda.

Special attention was paid to improved cultivation of plantain gardens which are generally in an appalling state, better spacing of cotton and planting across the slopes, and proper cultivation of coffee. A study was made of local customs with regard to agriculture and a number of interesting facts were obtained especially in connection with coffee cultivation and rotations.

G. W. NYE,

Senior Botanist.

PART III.—BOTANICAL WORK, SERERE.

Meteorological Conditions, 1934/35.

Weather conditions at Serere and in Teso District were generally unfavourable for cotton. The yields obtained throughout the district were disappointingly low.

The total rainfall for the year 1934 was only 46·62 inches. This is rather more than 8 inches below the thirteen-year mean of 54·70 inches.

The heaviest rainfall occurred in July. This is an extremely critical month for the early sown cotton. August followed with low air temperatures and high humidity; these conditions resulted in the rapid spread of Blackarm disease. September and October were hot and dry. This checked Blackarm, but also caused considerable shedding on the early cotton.

A short wet spell from October 27th to November 11th brought on Blackarm once more. The rain in December and February (1935) damaged a considerable proportion of the crop when it was still in the field. The January pickings gave the best grade.

A glance at the following table explains the unexpected success of the June sowing date in the large experiment at Serere. Usually May is the optimum sowing date, but in the season under review, as in the bad Blackarm year 1929-30, the optimum sowing date was June—July.

The June plantings had the best conditions, both for germination and growth of the seedlings, although the weather was rather too cold in July. However, the dry and hot weather following this checked Blackarm on these sowings. The early plantings on the other hand had poor conditions for seedling growth; the wet July caused undue vegetative growth and spread Blackarm, and the subsequent dry hot spell caused a considerable amount of shedding. The June plantings, therefore, were less woody, freer from Blackarm infection, and suffered less shedding than the April and May plantings.

Serere 1934/35 Weather Conditions.

Month.	Rainfall.	Sunshine.	Air temperatures.	Remarks.
1934.				
April ...	Just below average.	Average ...	Above average.	Rather hotter and drier than usual.
May ...	Nearly 1½ inches below average.	Above average.	Below average.	Second half of the month unsuitable for successful cotton planting.
June ...	Just below average.	Much above average.	Below average.	First half of month dry, second half suitable for cotton planting.
July ...	Nearly 3¾ inches above average.	Average ...	Much below average.	Very wet and cold—good planting weather but brought on heavy infection of Blackarm on April and early May plantings. Very good for late June plantings.
August ...	Below average.	Much below average.	Much below average.	Drier than usual, but temperatures low and weather cloudy, this increased Blackarm.
September ...	Very much below average	Much above average.	Much above average.	Dry and hot—checked Blackarm and also tended to check growth.
October ...	Well below average.	Above average.	Much above average.	do do do
November ...	Below average.	About average.	Just below average.	Blackarm increased during wet period October 27th—November 11th. Remainder of November dry.
December ...	Above average.	Just below average.	Just below average.	Rain caused damage to ripening cotton.
1935.				
January ...	No rain ...	Above average.	Much above average.	Ideal cotton ripening weather—grade improved.
February ...	Above average.	Below average.	Below average.	Rain damaged the final part of the crop.
March ...	Much below average.	Much above average.	Very much above average.	Cotton buying finished at month end.

Diseases and Pests.—This subject is dealt with in the reports of the Mycologist and Government Entomologist. Particular attention is drawn to the results of the Blackarm Lesion Counts made on the Serere Variety, Sowing Date and Dusting Trial and the District Variety Trials. These are to be found in the Mycologist's annual report.

As far as Blackarm is concerned it can be said that the Season 1934/35 was worse than normal in Teso District. The selection work which has gone on for several seasons has resulted in the production of several promising strains which show very high resistance to this disease. The general reduction in yield for the season cannot be ascribed entirely to Blackarm disease. There appear to be other factors at work, the nature of which are not at all clear, but further analysis of the vagaries of climate over a series of years should lead to some interesting conclusions. The breakdown of S.G. 29 is certainly very largely due to its marked susceptibility to Blackarm disease.

The Cotton Breeding Plot.

Pedigree Lines.—Ten strains were planted as follows:—

S.P. 80—S.P. 85 ... Derived from U. 4/4/2 *via* S.P. 13.
S.P. 86 and S.P. 87 ... Derived from U. 4/4/2 *via* S.P. 14.
S.P. 88 ... ... Derived from a selection originally made at Nariama (N. 17).
S.P. 89 ... ... Derived from a possible hybrid between S.G. 29 and U. 4.

One hundred plants of each strain were sown in rows of 50 plants each, separated by control rows of S.G. 29.

Numbers S.P. 80, 81, 82, 83 and 85 gave unsatisfactory lint although they were extremely resistant to Blackarm disease.

The lint of Numbers S.P. 84, 87, 88 and 89 was classed above S.G. 29 by local brokers.

New Selections.—219 new selections were planted:—

	Nyasaland Upland Group.—	
4	S.G. 29 derivatives	S. 101—104.
17	Nariama (N. 17) derivatives	S. 105—120.
1	N. 17 derivative from Kagwara	S. 121.
6	N. 24 derivatives	S. 122—127.
2	1933 Field Selections...	S. 128—129.
	Cambodia Group.—	
1	Cambodia selection	S. 130.
	Acala Group.—	
3	Acala selections	S. 131—133.
	U. 4 Group.—	
3	Selections from bulk U. 4	S.U. 61—63.
15	Selections from U. 4/130 Southern Rhodesia	S.U. 64—78.
16	Selections from U. 4/4 from Kenya	S.U. 79—94.
69	Selections from U. 4/4/2 Barberton	S.U. 95—163.
1	Selection from U. 4/4/10 Barberton	S.U. 164.
	Trinidad Hybrids.—	
19	Local Selections from 2(U. 4) × Jamaica xerophytic	T. 1—8. T. 26—T. 36.
8	Local Selections from Cambodia × U. 4 × Jamaica xerophytic ...	T. 9—16.
9	Local Selections from 2(Cambodia) × Jamaica xerophytic	T. 17—25.
7	Local Selections from U. 4 × Meade	T. 37—T. 43.
1	Local Selection from Cambodia × Gambia × U. 4	T. 44.
1	Local Selection from U. 4 × Gambia × Galapagos	T. 45.
3	Rows from (Cambodia × Jamaica Zerophy) × U. 4	T. 46—48.
3	Rows from (U. 4 × Jamaica Zerophy) × Upland	T. 49—T. 51.
14	Rows from (U. 4 × Cambodia) × U. 4	T. 52—65.
3	Rows from (U. 4 × Gambia 14) × U. 4	T. 66—68.
5	Rows from (U. 4 × Gambia 14) × Cambodia	T. 69—T. 73.
8	Rows from (U. 4 × Cambodia) × U. 4	T. 74—T. 81.

General.—The plot was planted on July 5th. The conditions were good, but the original germination averaged less than 60%. After resowings a good stand was obtained.

Rain in November and December caused a high proportion of rain-stained cotton. Despite a heavy Blackarm infection on the unselected S.G. 29 control rows many of the strains showed marked tolerance to this disease – particularly the Pedigree Lines.

Diseases and Pests.—The Mycologist and the Entomologist's native observers examined every plant in the Breeding Plot. The former's final count of the actual number of Blackarm lesions per plant made on November 9th, proved extremely useful for purposes of selection. The following table emphasises the marked resistance to Blackarm of the Pedigree Lines as compared with the control S.G. 29.

Table showing number of Blackarm lesions per plant on two rows of 50 plants each of the Pedigree Lines with the numbers of lesions on control rows of S.G. 29 :—

Strain.	No. of lesions per plant.	Strain.	No. of lesions per plant.
S.G. 29	2·02	S.G. 29	4·23
S.P. 80	nil	S.P. 85	0·24
S.G. 29	1·69	S.G. 29	4·05
S.P. 80	nil	S.P. 85	0·10
S.G. 29	3·15	S.G. 29	4·08
S.P. 81	nil	S.P. 86	0·02
S.G. 29	2·23	S.G. 29	2·75
S.P. 81	nil	S.P. 86	nil
S.G. 29	3·67	S.G. 29	1·92
S.P. 82	nil	S.P. 87	0·02
S.G. 29	3·14	S.G. 29	2·44
S.P. 82	nil	S.P. 87	0·11
S.G. 29	3·09	S.G. 29	2·91
S.P. 83	nil	S.P. 88	0·14
S.G. 29	3·48	S.G. 29	3·18
S.P. 83	nil	S.P. 88	nil
S.G. 29	3·41	S.G. 29	2·30
S.P. 84	nil	S.P. 89	0·10
S.G. 29	3·79	S.G. 29	2·52
S.P. 84	nil	S.P. 89	0·10
S.G. 29	4·23	S.G. 29	1·31

It will be noted that the strains S.P. 80—84 are more resistant than the remaining S.P.s. S.P. 85 showed three plants with marked susceptibility, the remainder being free. These strains, S.P. 80—85, are derived from Barberton U. 4/4/2 *via* S.P. 13.

Lint.—As in the previous season there was a very much higher proportion of immature lint in all the strains. The length of staple remained about the same but the weight of lint per seed and the weight per seed is markedly lower in the season under review.

The following tables summarise the characters of the more promising Pedigree Lines.

Biological Characters.

	Habit.	Blackarm Lesions per plant.	Flowers per plant.	Bolls per plant.	Shedding %
S.P. 84 ...	Good. Bushy. Monopodia turn up well. Regular.	Nil	41·65	13·43	67·8
S.P. 86 ...	Bushy. Rather irregular	0·01	46·27	14·92	67·8
S.P. 87 ...	Good. Regular	0·07	42·83	12·95	69·8
S.P. 88 ...	Poor, but slightly better than S.G. 29 ...	0·07	36·80	9·24	74·9
S.P. 89 ...	Good. Bushy. Monopodia turn up well	0·10	49·81	12·43	75·1

Boll Characters.

	Bolls per plant.	Loculus number.	Sound loculi per plant.	Seed cotton per plant. gms.	Lint per plant. gms.	Ginning Percentage.	Lint length. mm.
S.P. 84	13·43	4·18	11·20	40·18	13·96	34·7	31·21
S.P. 86	14·92	4·25	14·77	44·68	14·77	33·1	32·42
S.P. 87	12·95	4·36	12·69	42·32	15·04	36·5	32·22
S.P. 88	9·24	4·24	8·42	28·75	8·71	30·3	31·13
S.P. 89	12·43	4·23	11·60	36·12	11·16	30·9	32·18

Pedigree Lines.

In view of the local brokers' opinions and the satisfactory behaviour of S.P. 87, it has been decided that this strain will be increased as rapidly as possible to follow S.P. 1 and S.P. 20 through the Mulondo Segregated Area. The success of this strain is particularly gratifying as it was derived from S.P. 14, one of the two original selections made from Parnell's U. 4/4/2. Up to the third generation,

all the S.P. 14 derivatives gave lower yields, lower ginning outturn, less resistance to Blackarm and Jassids, but longer lint than the related S.P. 13 derivatives In the fourth generation (S.P. 87) the ginning outturn is as high, the yield is probably very little, if at all, inferior to, the resistance to Blackarm is nearly as high as (only 6 plants out of 93 showed any lesions) the typical S.P. 13 derivatives; while the lint was classed as superior to S.G. 29 by local brokers.

S.P. 84 is a derivative of S.P. 13, and has all the attributes of this group, except that its ginning percentage is rather lower, and that its lint has been classed as superior to S.G. 29 by local brokers. This strain will be treated as a second string to S.P. 87. Further selection will be made in both.

S.P. 88—A Nariama derivative—although still having a low yield, has lint far in advance of any of its predecessors. Further selection will be made in this strain.

S.P. 89 is still splitting badly for ginning percentage, Blackarm resistance and lint length. It is hoped that further selection will effect a marked improvement in these characters. As it stands now the lint is extremely satisfactory, but the strain cannot be increased in its present state for the reasons given above.

S.P. 86 is a close relation to S.P. 87. Its lint is markedly inferior in character although slightly longer than the latter's, and its ginning percentage is also lower. Potentially it is an extremely high yielding strain. Further selection will be done.

New Selections.

S. Series.—The most promising line of this series was S. 107. This is a Nariama derivative, and although having the highest potential yield of the Nyasaland Uplands is still a lower yielder than the U. 4/4/2 derivatives included in the S.U. series.

S.U. Series.—One promising strain—S.U. 63—is derived from U. 4 bulk. Three promising strains—S.U. 82, 85 and 94—resulted from selections made in U. 4/4 bulk received from Kenya. The two most outstanding strains in this series were S.U. 132 and S.U. 133. Both these are derived from U. 4/4/2 *via* S.P. 13, S.P. 22 and S.P. 47.

T. Series (*Trinidad Hybrids*).—The potential yield of all these strains is still below that of the S.U. Series. The most outstanding were derived from the following crosses: (U. 4 x Cambodia) x U. 4; 2 (U. 4) x Jamaica Xerophytic, and (Cambodia x U. 4) x Jamaica Xerophytic.

The following table shows the more important characters of the outstanding strains in the New Selection Series:—

Number.	Source.	Lint per Plant. gms.	Ginning Percentage.	Blackarm Lesions per Plant.
S. 107	Nariama Nyasaland Upland	9·20	32·9	Nil.
S.U. 63	U. 4 Bulk	10·66	33·6	Nil.
S.U. 82	U. 4/4	10·58	36·3	Nil.
S.U. 85		10·17	36·0	Nil.
S.U. 94		13·53	36·0	Nil.
S.U. 99	U. 4/4/2 *via* S.P. 39 ...	17·06	37·0	Nil.
S.U. 103	U. 4/4/2 *via* S.P. 40 ...	16·37	37·9	Nil.
S.U. 132	U. 4/4/2 *via* S.P. 47 ...	17·50	36·9	Nil.
S.U. 133	U. 4/4/2 *via* S.P. 47 ...	17·94	36·0	Nil.
T. 6	2 U. 4 x Jamaica Xerophytic	11·90	34·7	Nil.
T. 10	(Cambodia x U. 4) x Jamaica Xerophytic	10·30	30·2	0·04
T. 74	2 (U. 4) x Jamaica Xerophytic	10·81	32·0	Nil.
T. 77	(U. 4 x Cambodia) x U. 4.	13·53	33·8	0·04
T. 80		12·06	35·1	Nil.
T. 81		14·36	34·8	Nil.

Miniature Variety Trial, Serere.

This experiment consisted of 136 one-row plots of 17 varieties, replicated 8 times in random blocks. Each sub-plot consisted of one row of 50 plants, at 3 ft. by 1 ft. spacing.

The object of this experiment was to test a number of promising strains of which insufficient seed was available for inclusion in larger trials. The experiment was a distinct success, as it

demonstrated differences between varieties for infection of Angular Leaf Spot, degree of *Lygus* damage, number of Blackarm lesions per plant and final yield of seed cotton. These results are included in the following table:—

MINIATURE VARIETY TRIAL, 1934/35, SERERE. VARIETY TOTALS.

Variety.	1st Germination. July 30, 1934.	1st A.L.S. % plants attacked.	2nd A.L.S. September 9, 1934.	Lygus Damage. October 11, 1934.	Jassids/Leaf/ Plant × 10 December 15, 1934.	Stand on December 15, 1934.	Jassids Corrected for Stand.	Blackarm Lesions per plant. November 13, 1934.	Final Yield. Lbs.
N. 17	114	133·5	643	21·5	205	317	213·1	7·09	8·55
S.G. 29	98	58·8	651	21·9	121	271	128·0	9·85	5·19
S. 48	119	37·3	450	18·8	167	293	174·5	0·81	8·61
S.P. 36	139	41·0	419	22·4	155	310	163·0	1·33	5·28
S.P. 71	147	44·0	475	23·3	164	276	171·1	1·07	5·59
S.P. 72	126	52·0	513	21·9	159	296	166·6	1·09	5·90
U. 4/4/K.	116	49·5	513	21·6	169	307	176·9	1·55	13·18
S.P. 1	114	2·9	335	17·7	151	279	158·2	0·03	8·92
S.P. 13	100	15·1	274	18·4	126	283	133·3	0·03	9·24
S.P. 20	116	38·7	393	19·6	124	326	132·4	0·37	10·49
S.P. 39	112	15·3	314	20·6	146	300	153·7	0·14	10·34
S.P. 40	127	31·4	257	20·4	169	334	177·6	0·06	11·16
S.P. 43	117	10·4	262	20·3	163	324	171·3	0·13	11·54
S.P. 48	107	29·8	294	20·5	124	323	132·3	0·04	12·51
S.P. 25	108	99·1	640	19·4	160	287	167·4	0·70	8·50
S.P. 56	113	27·2	432	18·5	179	323	187·3	0·34	9·47
S.P. 57	128	22·2	310	20·3	162	321	170·2	0·15	14·22
L.S.D. ...	No Signifi-cance.	36	117	2·6	44	33	44·6	1·71	1·95

The outstanding results were:—

(*a*) N. 17 gave a significantly higher yield and developed fewer Blackarm lesions per plant than S.G. 29.

(*b*) All the selections showed considerably lower Blackarm infection than the two standard varieties N. 17 and S.G. 29.

(*c*) The high yields of S.P. 48 and S.P. 57. The latter is particularly encouraging as it is a reselection from S.P. 25 and has superior lint to the other U. 4/4/2 strains included in this trial.

COMBINED VARIETY, DUSTING AND SOWING DATE TRIAL, SERERE.

The lay-out for this experiment was decided upon after consultation with Mr. Yates of Rothamsted.

The experiment was conducted on Block "B" of the Experiment Farm. Standard plots (27 ft. by 27 ft.) and standard spacing (3 ft. by 1 ft.) were used. The lay-out was as follows:—

4 by 4 Latin Square for four sowing dates.

Each Sowing Date "cell" of the Latin Square divided into three strips of plots at random for the seed treatments Control, Dust 413a and Dust Abavit B. The six varieties were scattered at random in each seed treatment strip. The analysis of variance was therefore divided into three parts.

There were 48 replications of each variety irrespective of sowing date or seed treatment, and 96 replications of each seed treatment irrespective of variety or sowing date. This is the first occasion on which such a large comprehensive experiment has been conducted in Uganda and the accuracy of the results have well warranted the labour involved.

The different treatments were as follows:—

Sowing Dates.—24th April.
15th May.
12th June.
16th July.

Seed Treatments.—Control.
Dust—413A.
Dust—Abavit B.

Varieties.—S.G. 29—control.
S.P. 1.
S.P. 20.
S.P. 21.
S.P. 48.
S.P. 72.

The analyses of variance for yields of total cotton and clean cotton are as follows:—

ANALYSIS OF VARIANCE.—TOTAL COTTON.

		°F.	S. of S.	V.	Q.	P.
1st Part ...	Total ...	15	596·9876	...	...	...
	Rows ...	3	41·6053	...	...	...
	Columns ...	3	204·2718	...	...	...
	S.D. (S.) ...	3	250·6242	83·5414	4·9882	<0·05
	Errors ...	6	100·4863	16·7477	...	...
2nd Part ...	Total ...	47	671·7192	...	...	...
	1st Part ...	15	596·9876	...	...	...
	Dusts (D.) ...	2	0·6970	0·3485	0·1752	No significance.
	S. × D. ...	6	26·2811	4·3802	2·2014	No significance.
	Errors ...	24	47·7535	1·9897	...	...
3rd Part ...	Total ...	287	1,907·6009	...	...	...
	2nd Part ...	47	671·7192	...	...	...
	Varieties (V.) ...	5	887·2509	177·4502	118·0799	<·01
	V. × S. ...	15	37·1808	2·4787	1·6494	No significance.
	V. × D. ...	10	10·5995	1·0600	<1·0	No significance.
	V. × S. × D. ...	30	30·3524	1·0117	<1·0	No significance.
	Errors ...	180	270·4981	1·5028	...	...

Least Significant Difference ... Variety Totals, 24·02 lbs.
Sowing Date Totals, 120·17 lbs.
Dust Totals, 20·17 lbs.

ANALYSIS OF VARIANCE.—CLEAN COTTON.

		°F.	S. of S.	V.	Q.	P.
1st Part ...	Total	15	405·2480	...	...	...
	Rows	3	9·2515	...	...	...
	Columns ...	3	70·6226	...	...	...
	Sowing Dates (S.) ...	3	268·6386	89·5462	9·4699	<0·05
	Errors	6	56·7353	9·4559	...	...
2nd Part ...	Total	47	437·8440	...	...	...
	1st Part ...	15	405·2480	...	...	...
	Dusts (D.) ...	2	0·3281	0·1641	0·0201	No significance.
	S. × D.	6	12·7129	2·1188	2·6004	<0·05
	Errors	24	19·5550	0·8148	...	...
3rd Part ...	Total	287	934·9695	...	...	...
	2nd Part ...	47	437·8440	...	...	...
	Varieties (V.) ...	5	307·8041	61·5608	80·9584	<0·01
	V. × S. ...	15	32·7279	2·1819	2·8694	<0·01
	V. × D. ...	10	5·4692	0·5469	<1·0	No significance.
	V. × S. × D. ...	30	14·2579	0·4753	<1·0	No significance.
	Errors	180	136·8664	0·7604	...	...

Least Significant Difference ... Variety Totals, 17·30 lbs.
Sowing Date Totals, 90·29 lbs.
Dust Totals, 12·97 lbs.

The following tables indicate the results after converting the actual yields to yields per acre:—

VARIETIES (Irrespective of Sowing Date or Seed Treatment).

	Total cotton lbs./acre.	Significant difference lbs./acre.	Clean cotton lbs./acre.	Significant difference lbs./acre.
Control S.G. 29	234	26	164	19
S.P. 1	384		249	
S.P. 20	418		270	
S.P. 21	429		273	
S.P. 48	481		306	
S.P. 72	256		168	

Sowing Dates (Irrespective of Variety or Seed Treatment).

	Total cotton lbs./acre.	Significant difference lbs./acre.	Clean cotton lbs./acre.	Significant difference lbs./acre.
April	316	87	177	65
May	336		205	
June	443		304	
July	373		268	

Seed Treatments (Irrespective of Sowing Date or Variety).

	Total cotton lbs./acre.	Significant difference lbs./acre.	Clean cotton lbs./acre.	Significant difference lbs./acre.
Control	359	39	236	25
Abavit B.	370		240	
413a.	367		239	

None of the interactions are significant with total yields. However, the interactions of Sowing Date × Seed Treatment and Variety × Sowing Date are significant for yields of clean cotton.

Interaction of Sowing Date × Seed Treatment. Yields of Clean Cotton. Lbs./Acre.

	Control.	Abavit B.	413a.
April	187	174	173
May	207	210	200
June	278	322	315
July	276	259	270

Least significant difference between any entry in above table 28 lbs. per acre.

Interaction of Variety × Sowing Date. Yields of Clean Cotton. Lbs./Acre.

	April.	May.	June.	July.
S.G. 29	122	145	201	191
S.P. 1	179	218	319	283
S.P. 20	211	227	339	305
S.P. 21	215	224	342	314
S.P. 48	205	265	404	353
S.P. 72	135	152	224	164

Least significant difference between any entry in the above table 37 lbs. per acre.

Discussion of Results.

Varieties (Irrespective of Sowing Dates or Seed Treatments)—

Total Cotton.—

S.P. 48 significantly higher yielder than all others.

S.P. 21 equal to S.P. 20; both significantly higher yielders than S.P. 1, S.P. 72 and S.G. 29.

S.P. 1 significantly higher yield than S.P. 72 and S.G. 29.

S.P. 72 equal to S.G. 29.

Clean Cotton.—

Results same as for Total Cotton.

Sowing Dates (Irrespective of Seed Treatments or Varieties)—

Total Cotton.—

June equal to July.

June better than May and April.

July, May and April all equal.

Clean Cotton.—

June equal to July.

June better than May and April.

July better than April but equal to May.

Seed Treatments (Irrespective of Sowing Dates and Varieties)—

Dusts had no effect on general yield.

Interaction of Sowing Date × Seed Treatment—

Seed Treatments showed no differences in April, May and July.

But in June, both dusts resulted in a significant increase of yield over control.

Interaction of Variety × Sowing Date.

The nature of this interaction is rather obscure: to simplify matters the following table is appended. In this each varietal monthly mean is expressed as a percentage of the mean yield of all varieties for the appropriate month.

	April.	May.	June.	July.
S.G. 29	68·7	70·4	65·9	71·2
S.P. 1	100·6	106·1	104·6	105·4
S.P. 20	118·5	110·6	111·2	113·6
S.P. 21	120·8	109·4	112·2	117·1
S.P. 48	115·3	129·3	132·6	131·5
S.P. 72	76·1	74·3	73·5	61·1

From this it will be seen that the varieties responded in different ways to the four sowing dates, *viz*:—

S.G. 29 gave the best relative yields in May and July.

S.P. 1 gave a low relative yield in April.

S.P. 20 and S.P. 21 (very closely related) gave relatively high yields in April and July.

S.P. 48 gave its highest relative yields in June and July.

S.P. 72 gave lower relative yields as the sowing date became later.

The most outstanding results are: The obvious preference of S.P. 48 for late planting and its enormous increase over S.G. 29; the increase of yield of successive generations S.P. 1, S.P. 20 and S.P. 21, and S.P. 48 (all U. 4/4/2 derivatives); the failure of dusts to alter general yield except during June, despite the significant reduction of Blackarm infection (*vide* the Mycologist's Annual Report); the shift of the optimum sowing date from May to June—July as in the previous bad Blackarm year 1929-30; the extraordinary accuracy of this complex experiment, the standard error of a single plot being 1% of the general mean and differences of only 7·1% of the general mean demonstrate significant differences between variety totals.

Owing to the success of this experiment a similar complex experiment of 288 sub-plots is to be laid down in the 1935/36 season substituting three spacings for the three seed treatments.

District Variety Trials.

As in previous seasons, 4 by 4 Latin Squares were laid down at different centres scattered over the area East of the Nile. An additional centre was included in Busoga bringing the total number of Trials up to eleven. The following tables summarise the results, calculating each trial as a separate entity and combining all centres into one large trial with replication of centres. It will be noted that Mbale is only included in the total yields as the seed cotton was lost before it could be picked over and ginned.

Total Yield.—Mean yields of each variety at each centre expressed as pounds of seed cotton per acre, together with the least significant difference at each centre and for the combination of all centres.

Centre.		S.P. 20.	S.P. 1.	N. 17.	S.G. 29.	Least Significant difference.
LANGO ...	Aduku ...	1,033	957	778	632	199
	Kaberamaido ...	761	690	533	446	152
	Ngetta ...	601	533	666	381	170
TESO ...	Nyero ...	530	509	327	214	204
BUGWERE ...	Mbale ...	1,521	1,287	1,534	1,222	221
	Kibale ...	659	649	494	448	124
BUDAMA ...	Mulanda ...	857	796	526	535	88
BUSOGA ...	Vukula ...	658	857	644	629	...
	Bugaya ...	252	271	223	202	...
	Bulopa ...	576	517	494	482	...
	Wanyange ...	1,094	824	1,042	754	...
General Means ...		777	717	660	540	51
Mean Yields as percentage of S.G. 29 ...		143·9	132·8	122·2	100·0	...

The general mean for all varieties at all centres was 674 lbs. per acre. Differences between varieties of more than 7·6% of the general mean show significance.

Conclusions (Combining all centres):—

(*a*) S.P. 20 significantly better than S.P. 1.

(*b*) S.P. 1 significantly better than N. 17.

(*c*) N. 17 significantly better than S.G. 29.

(*d*) Interaction of Variety × Centre highly significant because S.P. 20 and S.P. 1 gave higher yields relative to N. 17 and S.G. 29 in Lango, Teso, Bugwere and Budama than in Busoga.

The failure of S.G. 29 as compared with N. 17 was foreshadowed in the Mycologist's Blackarm infection figures.

With the exception of the Mbale cotton and the Lango trials, all plots were ginned individually on Platt's Roller Gins at Agu Ginnery by courtesy of Messrs. East African Ginneries, Ltd. The Lango plots were ginned on a 12-inch hand gin, and the seed destroyed owing to the risk of Pink Bollworm infection.

The mean Ginning Percentage of the varieties were:—

S.P. 20	... ...	37·5%
S.P. 1	... ...	36·3%
N. 17	... ...	30·8%
S.G. 29	... ...	31·8%

Lint Yields.—Mean yields of each variety at each centre expressed as pounds of lint cotton per acre, together with the least significant differences.

Centre.		S.P. 20.	S.P. 1.	N. 17	S.G. 29	Least Significant Difference.
LANGO ...	Aduku	227	194	203	120	59
	Kaberamaido ...	396	356	241	206	75
	Ngetta	279	251	163	142	55
TESO ...	Nyero	201	180	99	67	30
BUGWERE	Kibale	244	236	152	142	47
BUDAMA	Mulanda	322	286	166	171	30
BUSOGA ...	Vukula	250	308	195	196	83
	Buyaga	94	97	67	64	...
	Bulopa	222	195	154	159	...
	Wanyange ...	399	297	323	233	107
General Means ...		263	240	176	150	19
Mean Yields as percentage of S. G. 29 ...		175·5	159·9	117·4	100·0	...

The general mean for all varieties at all centres was 207 lbs. of lint per acre.

Differences between varieties of more than 9·2% of the general mean demonstrated significance.

Conclusions (Combining all centres):—

(*a*) S.P. 20 significantly higher than S.P. 1.

(*b*) S.P. 1 significantly higher than N. 17.

(*c*) N. 17 significantly higher than S.G. 29.

(*d*) Interaction of Variety × Centre highly significant for similar reasons to those given under total yields.

Conclusion (*c*) is of interest when we compare the ginning percentage of N. 17 and S.G. 29. Despite the latter having a marked advantage over N. 17 in this respect, it still fails to come up to N. 17's mean yield of lint per acre.

The outstanding results are:—

(*a*) The failure of S.G. 29 as compared with N. 17 despite the better ginning percentage of the former.

(*b*) The success of S.P. 20 both in respect to yield and ginning percentage. The average yield of lint at ten centres is equivalent to well over half a bale per acre.

Katakwi, Usuku, Variety Trial.

In addition to the above District Variety Trials a 6 by 6 Latin Square was laid down at Katakwi in Usuku by the Agricultural Officer, Teso. The results were as follows:—

Variety.	Mean Yield. Lbs. seed cotton per acre.	Least significant difference. lbs./acre.
S.G. 29	86	
S.P. 36	133	
S.P. 71	130	
S.P. 1	103	29
S.P. 13	151	
S.P. 20	165	

Conclusions:—

(*a*) The Nariama derivatives originally selected in Usuku from N. 17 gave a very significantly higher yield than S.G. 29.

(*b*) S.P. 20 significantly better than S.P. 1, S.P. 71, S.P. 36 and S.G. 29.

These results are of interest when one considers that no difference in yield at Serere has been demonstrated between S.G. 29 and the Nariama derivatives, yet when the latter are returned to the place of origin they give a better yield than S.G. 29.

Cotton Seed Multiplication—Serere.

Quarter-Acre Increase Stage.

The following strains were planted in isolated ¼-acre plots:—

S.P. 39, S.P. 43, S.P. 48, S.P. 56, S.P. 72.

In addition, S.P. 13 was increased in the Isolated Plot Sowing Date Trial, and U. 4/4 from Kenya in the Manurial Experiment.

Satisfactory yields were obtained despite very poor stands due to shortage of seed in the case of the first five strains quoted.

Three-Acre Increase Stage.

This was planted with S.P. 20. The yield averaged 444 lbs. per acre. This gives ample seed for the 40-acre stage next season and all variety trials. The whole plot suffered very severely from Lygus damage in August, but made a remarkable recovery.

40-Acre Increase Stage.

The new 1934 Main Farm was planted with S.P. 1. Despite a very bad stand due to shortage of seed, adverse conditions at planting in the case of two of the blocks, and considerable loss of cotton from rats the yield averaged 476 lbs. per acre. From the first quality cotton eleven bales were obtained with a ginning percentage of 34·3%. This cotton was ginned by Messrs. Foster Bros. at their Bugondo Ginnery using Middleton gins. Ample first quality seed was produced to plant up the Mulondo Segregated Area in the coming season. The seed for both the 3-acre and 40-acre stage was dusted with 413a prior to planting.

Cotton Seed Multiplication—Segregated Areas.

A. Mulondo Area.—This area was again planted with S.G. 29 grown at Serere in the the previous season.

The monthly plantings were as follows:—

	May.	June.	July.	August.	September.	Total.
Acres ...	58·3	78·4	44·9	94·2	29·4	305·2

The total acreage in the previous season was 361·6. The reduction is partly explained by dry weather and shortage of food due to failure of the spring sown wimbi crops.

B. Labori-Kadunguru Area.—This area was planted with S.G. 29 grown in Mulondo in the previous season.

The monthly plantings were as follows:—

	May.	June.	July.	August.	September.	Total.
Acres ...	158·8	499·5	2,383·0	492·9	103·8	3,638·0

In the previous season the acreage totalled 4,820·9.

C. Serere-Kasilo Sazas.—Planted with S.G. 29 grown in the Labori-Kadunguru Area in the previous season.

The monthly plantings were as follows:—

	May.	June.	July.	August.	September.	Total.
Acres ...	1,352·2	5,587·1	10,955·2	6,237·6	1,182·3	25,314·4

The previous year's total was 28,736·5 acres. Most of this reduction took place in Kasilo Saza.

The buying returns and yields per acre were as follows:—

Area.	Purchases. Lbs. Seed Cotton.			Percentage of second and third quality.	Average yield per acre lbs. (all grades).
	1st quality.	2nd quality.	3rd quality.		
Mulondo	71,315	1,149	21,662	24·2	308
Labori—Kadunguru ...	498,533	13,350	102,645	18·8	169
Serere—Kasilo	3,468,448	169,257	412,268	14·4	160
Totals and Means ...	4,038,296	183,756	536,575	15·1	164

Total buyings of all grades in the three areas, 4,758,627 lbs. of seed cotton, compares very unfavourably with the 9,295,930 lbs. of the previous season—the latter is equivalent to an average yield per acre of 274 lbs.

Thus the yield per acre for the 1934/35 season is only 60% of that of the previous season.

Bad weather conditions, high proportion of late planted plots and high Blackarm infection contributed to this low yield.

Spinning Tests.

Shirley Institute.

The following 1933-34 lint samples were dealt with by the Shirley Institute, Didsbury:—

S.G. 29	Serere.
S.P. 1	Serere.
S.P. 13	Serere.
S.P. 20	Serere.
S.P. 21	Serere.
S.P. 36	Serere.
S.P. 13	Mulanda.
S.G. 29	Mulanda.
S.P. 13	Kibale.
S.G. 29	Kibale.

The reports on these samples are as follows:—

Measurable Characters.—"The S.G. 29 samples are similar to each other in length and are longer than the remaining samples, which are also much alike in length. Most of the samples have rather low percentages of normal hairs and high percentages of immature hairs; the least immature being the Mulanda and Kibale samples of S.P. 13 and the Mulanda samples of S.G. 29. On the whole, the Serere samples are more immature than the samples from the other localities."

Spinning Tests.—"The S.G. 29 samples are on the whole the strongest, the Serere samples being somewhat stronger than the Kibale and Mulanda samples. S.P. 36 from Serere is the strongest of the other samples; the remainder being very similar to each other in strength except S.P. 13 from Mulanda, which is the weakest."

Appearance of Yarns.—

"S.P. 1 and S.P. 20 from Serere are on the whole the best in yarn appearance."

"The superiority of the S.G. 29 samples is not so marked as in last year's tests, for whilst S.P. 1 and S.P. 13 have given similar results to last year, the S.G. 29 samples from Serere and Mulanda are distinctly poorer in spinning quality than the corresponding samples of last year. The measured hair characters supply no explanation of this difference."

Indian Technological Laboratory (I.C.C.C.).

Samples from the 1933-34 crop were sent to India for trial, but the results of these tests have not been received at the time of writing.

In "A Note on Uganda Cottons" written by the Director of the Technological Laboratory summarising the results of spinning tests on 1931-32 and 1932-33 samples the following statements warrant attention:—

". . . . the spinning performances of S.P. 1 and S.P. 13 are very nearly the same as those of Buganda Local cotton."

"The Grader's valuation shows S.G. 29 to be superior to, S.P. 1 to be equal to, and S.P. 13 to be inferior to Local Buganda cotton."

"The yarns spun from S.G. 29, S.P. 1 and Local Buganda are practically free from meps."

Brokers' Reports.

1934/35 Lint samples of fourteen of the later S.P. strains and Serere-grown S.G. 29 were submitted to local brokers for their opinions. For the first time S.G. 29 was classed well below the better U. 4/4/2 derivatives.

The concensus of opinion gave the following order:—

1st	...	S.P. 89	... Possible hybrid between S.G. 29 and U. 4.
		S.P. 88	... Nariama derivative
2nd	...	S.P. 87	... U. 4/4/2 derivative *via* S.P. 14.
3rd	...	S.P. 84	... U. 4/4/2 derivative *via* S.P. 13.
4th	...	S.P. 56	... U. 4/4/2 derivative *via* S.P. 14.

The reasons given for not placing S.G. 29 in the first group were:—

(*a*) Bad colour (greyish).
(*b*) Irregularity of staple.

The U. 4/4/2 derivatives were stated to have extremely good bright colour. This is a very gratifying result, particularly as both S.P. 87 and S.P. 84 are potentially high yielders and have marked resistance to Blackarm disease. S.P. 87 is to be planted in the 3-acre stage next season to follow S.P. 1 and S.P. 20 through Mulondo.

Isolated Plot Cotton Sowing Date Trial, Serere.

Doubts have frequently been cast on the validity of the usual type of sowing date trials where the sowing dates are scattered at random in adjoining plots and treated as ordinary treatments because, it is said, the earlier sowings attract insects and pests and act as a focus of infection, consequently biassing the results.

To meet this criticism an experiment was laid down at Serere on virgin ground. It took the form of a 6 by 6 Latin Square, but instead of having a continuous plot lay-out, a space of several yards of ordinary bush separated each plot from another.

In the 1933/34 season this experiment was put down to test six sowing dates ranging from April 20th to August 12th. As was to be expected the uncontrolled fertility differences were too great to show any significant differences between sowing dates.

In the following season the 36 plots were treated as a uniformity trial, *i.e.*, were all planted on the same date. It was hoped that by using the method of covariance the uncontrolled differences could be corrected by means of the uniformity trial results. However, despite a marked improvement in accuracy, the results were again not significant. The results are as follows:—

Total Yields of Six Plots. Lbs. of Seed Cotton.

Sowing Dates.	1933/34 Yields (Y).	1934/35 Yields (X).	BX.	Y+Y—BX.
April 20th	43·67	38·20	49·17	37·03
May 1st	47·03	37·40	48·14	41·32
May 15th	42·97	41·41	53·30	32·10
June 17th	38·72	33·09	42·59	38·56
July 15th	42·91	34·10	43·89	41·45
August 12th	39·28	34·42	44·31	37·40
Significant differences	24·87	12·54	...	20·44

The experiment will be continued as there are signs that the method of covariance may show significant differences between sowing dates.

Cotton Sowing Date and Spacing Trial.

Serere—With Variety S.G. 29.

This experiment took the form of a duplicated 3 by 3 Latin Square for Sowing Dates. Each Sowing Date "cell" was divided at random into the three spacings.

A similar experiment was conducted in the previous season so that two seasons results could be combined in one analysis of variance.

The results for the 1934/35 season were as follows:—

1934/35 Yields of Seed Cotton. Lbs. per Acre.

Sowing Dates irrespective of Spacings.	Yield per acre.	Significant difference.
May 16th	387	
June 17th	418	57
July 15th	431	

No significant difference between Sowing Dates.

Spacings irrespective of Sowing Dates.	Yield per acre.	Significant difference.
3 ft. by 3 ins.	396	
3 ft. by 6 ins.	421	26
3 ft. by 1 ft.	420	

No significant difference between Spacings.

The Interaction of Sowing Date × Spacing was highly significant because:—

(*a*) In May there was no difference between Spacings.

(*b*) In June 3 ft. by 1 ft. gave a better yield than the two closer spacings.

(*c*) In July the two close spacings gave a better yield than 3 ft. by 1 ft.

Combining the results of the two Seasons 1933/34 and 1934/35 the following results were obtained:—

Combining Two Seasons 1933/34 and 1934/35. Yields of Seed Cotton. Lbs. per Acre.

Sowing Dates irrespective of spacing.	Yield per acre.	Significant difference.
May	314	
June	300	32
July	288	

No significant difference between Sowing Dates.

Spacings irrespective of Sowing Dates.	Yield per arce.	Significant difference.
3 ft. by 3 ins.	286	
3 ft. by 6 ins.	306	20
3 ft. by 1 ft.	309	

3 ft. by 1 ft. and 3 ft. by 6 ins. significantly better than 3 ft. by 3 ins.

The Interaction Seasons × Sowing Dates highly significant because in the 1933/34 season May gave a better yield than June which gave a better yield than July. In the 1934/35 season the order was exactly reversed.

The interaction of Seasons × Spacings was not significant.

The Interaction of Spacings × Sowing Dates was significant because 3 ft. by 1 ft. gave the best yield for May and June sowing dates, whereas 3 ft. by 6 ins. gave the best for July.

Manurial Experiment, Serere.

A 5 by 5 Latin Square was laid down in 1933 to compare varying amounts of farmyard manure applied with a green manure, lime applied with a green manure, and green manure only.

The rotation is as follows:—

1933 ... Green manure plus treatment, except for control which is green manure only.
Early Cotton.

1934 ... Cotton uprooted.
Bulo (*Eleusine coracana*).
Late Cotton.

1935 ... Groundnuts.
Green Manure.

The treatments are:—

A. Control, green manure only.
B. Green manure plus Lime 2 tons per acre.
C. Green manure plus farmyard manure 10 tons per acre.
D. Green manure plus farmyard manure 20 tons per acre.
E. Green manure plus farmyard manure 30 tons per acre.

The sub-plots are 29 ft. by 77 ft. with 8 footpaths between all plots and small ditches to prevent the manure being washed into adjoining control plots.

The results to date are as follows:—

MEAN YIELDS IN LBS. PER ACRE.

Treatment.	1933/34 Cotton. Variety S.G. 39. Lbs. per acre. Seed Cotton.	1934 Bulo. Lbs. per acre unthreshed.	1934/35 Cotton. Variety U. 4/4. Lbs./acre. Seed Cotton.
Control	390	1,861	445
Lime 2 tons	332	2,372	410
F.Y.M. 10 tons	390	2,403	579
F.Y.M. 20 tons	364	2,193	567
F.Y.M. 30 tons	283	2,399	577
Significant difference ...	No significance	No significance	130

In 1933/34 the differences between the treatments for yields of cotton are not significant. The first real significances were obtained in the 1934/35 cotton, *i.e.*, the third crop since the application of the manure, and here the three farmyard manure treatments were significantly better than the control and limed plots. The difference in yield of the two cotton crops is striking. The 1934/35 season was a bad one, but the strain U. 4/4 is a much higher yielder than S.G. 29, hence the latter season gave apparently higher yields than the first season.

If we take the value of cotton to be 10 cents per pound and unthreshed bulo to be 1 cent per pound, then the Gross returns per acre for two cotton crops and one bulo crop with only one application of manures are as follows:—

Treatment.	Gross return shillings per acre for two cotton crops and one bulo crop.
Control	Shs. 102·11
Lime 2 tons	Shs. 97·85
F.Y.M. 10 tons	Shs. 121·01
F.Y.M. 20 tons	Shs. 115·06
F.Y.M. 30 tons	Shs. 109·97
Significant difference ...	No significance.

The above Gross cash returns show no significant differences. If is hoped that the groundnut crop in 1935 will bring these results to the level of significance.

GROUNDNUTS.

Breeding Plot.

Thirty-five Spreading type and forty-six Bunch type selections were planted in 25 plant rows for observation on Rosette disease, etc., and analysis of single plant yields.

The most successful strain was No. 235. This is derived from Phillipine Pink from the Gambia, first grown at Serere in 1932. This strain was outstanding for pod yield, yield of nuts per plant and freedom from Rosette. A curious point about this strain is that it always develops an appearance of leaf crinkle in its younger stages. This leaf crinkle may or may not wear off as the season advances. Thirty-one single plant selections were made in the Spreading group and twenty-one in the Bunch. These will be planted out as progeny rows next season.

The strain 235 will be increased as quickly as possible.

Combined Mulching and Variety Trial.

This took the form of a 10 ft. by 10 ft. Latin Square. Five varieties were combined with Mulched and Unmulched treatments. The mulch applied was a layer of Lusenke (*Imperata cylindrica*) grass about one inch thick covering the soil between the rows. Plots 20 ft. by 20 ft. were used with 1 ft. by 1 ft. spacing.

The results were as follows:—

Unshelled Yields. Lbs./Acre. (Means).

Variety.	Mulched.	Control.	Varieties irrespective of treatments.
Mass selected Bunch	1,789	1,342	1,565
Tanganyika Bunch	1,745	1,283	1,514
Local Spreading	785	822	803
Virginia Bunch	1,576	1,257	1,416
African Bunch	1,664	1,315	1,490
Treatments irrespective of variety	1,512	1,204	...

Least significant difference.—Varieties ... ... 119 lbs./acre.
Mulched v. Control ... 75 lbs./acre.
Combined Treatments ... 168 lbs./acre.

Conclusions:

Mulching.—Increases yield of the Bunch varieties but does not affect the yield of Spreading.

Varieties.—Local Spreading significantly worse than all the Bunch varieties.

Mass selected Bunch significantly better than Virginia Bunch. No other differences between the Bunch varieties.

Yields of Shelled Nuts—Lbs./Acre. (Means).

Variety.	Mulched.	Control.	Varieties irrespective of treatments.
Mass selected Bunch	1,220	842	1,031
Tanganyika Bunch	1,129	832	980
Local Spreading	557	581	569
Virginia Bunch	1,076	821	948
African Bunch	1,121	837	980
Treatments irrespective of variety ...	1,021	782	...

Least significant difference.—Varieties ... ... 105 lbs./acre.
Mulched v. Control ... 210 lbs./acre.
Combined Treatments ... 148 lbs./acre.

Conclusions:

Mulching.—Increases yield of the Bunch varieties but has no effect on the Spreading.

Varieties.—Local Spreading significantly worse than all the Bunch varieties.

No difference between the Bunch varieties.

Shelling Percentage.

Variety.	Mulched.	Control.	Varieties irrespective of treatments.
Mass selected Bunch	68·15	63·15	65·65
Tanganyika Bunch	64·75	64·85	64·80
Local Speading	71·10	70·65	70·88
Virginia Bunch	68·55	65·15	66·85
African Bunch	67·40	64·25	65·83
Treatments irrespective of variety ...	67·99	65·61	...

No significant difference between the shelling percentage of varieties or treatments.

ROSETTE PERCENTAGE.

Variety.	Mulched.	Control.	Varietes irrespective of treatments.
Mass selected Bunch	0·78	0·90	0·84
Tanganyika Bunch	1·64	1·80	1·72
Local Spreading	1·94	3·58	2·76
Virginia Bunch	2·06	0·82	1·44
African Bunch	0·32	0·82	0·57
Treatments irrespective of variety ...	0·67	0·79	0·73

No significant difference between varieties or treatments.

SHEA NUTS.

The yield from the trees which are under observation was practically nil.

Some seed was obtained from Wera for germination trials. None of this seed germinated.

OIL PALMS.

After a grass fire in January a certain number of trees died. These blanks were supplied. Growth has been extremely slow.

CASSAVA.

The Mycologist introduced numerous varieties from different sources in an attempt to find a strain resistant to Mosaic. These strains are now under the charge of the Agricultural Officer, Teso.

BULO (*Eleusine coracana*).

420 single-plant selections and 11 varieties from Lango District were planted in lines. Observations were made by the Mycologist on the incidence of sterility and Blast Disease. There was a high incidence of sterile heads which resemble *Eleusine indica*.

227 single-plant re-selections were made.

TOBACCO.

An infection of *Rhizoctonia bataticola* occurred in the nursery beds. The Mycologist ascribed this to excessive shade.

Many plants died of Black Shank after becoming established in the field.

Five plants in each strain were bagged for seed.

A smoke-barn was erected and an attempt made to cure certain strains. After curing it has been found difficult to keep the tobacco moist enough to allow of handling.

Small samples of the more promising varieties have been sent to the Tobacco Officer for his opinion.

SUMMARY.

Owing to the unfavourable weather conditions and severe Blackarm disease, the yields were below average at Serere and in the Eastern Province.

S.G. 29, chiefly due to its susceptibility to Blackarm disease, gave a lower yield than N. 17.

In all variety trials the U. 4/4/2 derivatives again gave a much higher yield than either S.G. 29 or N. 17. For the first time, local Brokers have classed the better U. 4/4/2 derivatives over S.G. 29.

With their high resistance to Blackarm disease and drought, and with their high yield, and possibly with lint little, if at all, inferior to S.G. 29, there is every prospect of such strains as S.P. 87 proving a success in the Eastern Division. Increase of S.P. 87 will be done as fast as possible.

In a season with severe Blackarm disease, the dusts Abavit B. and 413a failed to produce an increase of yield over non-dusted seed.

The work done during the past five seasons has resulted in the production of strains which are so highly resistant to Blackarm that dusting becomes unnecessary.

PART IV.—BOTANICAL WORK, KAMPALA.

Staff.

Throughout the year Mr. Chandler was in charge of the Botanic Gardens, Entebbe, and of the work of propagation at Kampala, and while I was on leave, from May until November, he was in charge of the botanical work at Kampala.

Coffee.

A. SELECTION AND BREEDING.

2. *Selection.*—Observations were continued on the various selected trees, which were visited at intervals during the year, and notes were made upon their appearance and their crop; the importance of this repeated observation is very great for many trees, which had borne heavy crops in 1933, bore light ones in 1934. Small amounts of seed of many of the selections were sown at Kampala and the seedlings transplanted to supply material for progeny rows to be planted at Kawanda; and seedlings of twelve "Nganda" (spreading) selections and seven "Robusta" (erect) selections were supplied to the Senior Agricultural Officer, Kampala, for planting in experimental plots at Mukono. The work of collecting seed from these selected trees, to supply the seedlings raised for distribution, was handed over to the Senior Agricultural Officer, Kampala.

3. *Breeding.*—Observations on the Robusta coffee progeny rows on Plot 4, Kampala Plantation, were continued. Individual tree records of yields of fruit are being kept, and the cherry size and bean size are being investigated. Owing to the different systems of pruning which are being employed on the plot, it is not possible to form definite conclusions as to the relative values of the trees; but at the end of the year eight tentative selections were made on the characters of yield, bean size, and general appearance—healthy foliage, stout branching primary branches, etc. Seed of these trees from open pollination is being sown and will be planted in progeny rows, and attempts are being made to produce seed by self pollination.

4. *Self Pollination.*—At the beginning of the year extensive trials of self pollination were made. For this purpose there were used some of the small grafted trees of the selected clones, which were totally enclosed in cages of mosquito netting on a wooden framework, and branches of various selected trees which were enclosed in cylindrical sleeves of netting, held in shape with rings of bamboo; these covers were put in place when the flower buds were swelling rapidly (often about two days before they opened) and after any developing fruits had been removed. The actual pollination was done by three methods:—

(*a*) By dusting the flowers over with a camel hair brush, which was washed in methylated spirit before proceeding to the next tree.

(*b*) By picking off the stamens with forceps and rubbing the dehisced anthers against the stigmas.

(*c*) By means of enclosing a number of honey bees which had been caught the previous day and washed with water to remove any pollen on them. The Entomological Section gave much assistance with this work, and also with an abortive attempt to utilise the small native stingless bees, which together with honey bees, are the most important agents for coffee pollination in the field: the nests of these bees were dug out and placed in pots and it was hoped that the bees thus could be handled easily —unfortunately they deserted the nests.

The results of the self pollination are shown in the table below:—

TABLE I.—RESULTS OF SELF POLLINATION EXPERIMENTS ON COFFEE.

Selection Number.	Portion of tree employed.	Method of pollination.	Flowers pollinated.	Fruit set.	Percentage of fertilisation.
C. arabica 102	Small grafted tree ...	Brush ...	4,601	2,900	63
C. arabica 102	Small grafted tree ...	Bees ...	4,147	3,485	84
C. arabica 108	One primary branch ...	Brush ...	42	27	64
C. robusta 1	Small grafted tree ...	Brush ...	1,670	427	26
C. robusta 1	One primary branch ...	Forceps ...	143	64	45
C. robusta 1	One primary branch ...	Brush ...	131	23	18
C. robusta 2	Small grafted tree ...	Brush ...	992	63	6
C. robusta 2	One primary branch ...	Forceps ...	89	40	45
C. robusta 2	One primary branch ...	Brush ...	104	42	40
C. robusta 3	Small grafted tree ...	Brush ...	6,920	1,254	18
C. robusta 4	Small grafted tree ...	Brush ...	2,240	529	24
C. robusta 4	One primary branch ...	Brush ...	111	37	33
C. robusta 41	Small grafted tree ...	Brush ...	1,082	388	36
C. robusta 44	Small grafted tree ...	Brush ...	1,309	207	16
C. robusta 44	Small grafted tree ...	Bees ...	6,868	1,308	19
C. robusta 45	Small grafted tree ...	Brush ...	908	198	22
C. robusta 45	Small grafted tree ...	Bees ...	829	48	6

It is well known that *Coffea arabica* usually is highly self fertile, and the percentage of fertilisation was be expected to be high. But the results with *Coffea robusta* were unexpected, as workers in other countries have reported a low degree of self fertility, *e.g.*, about 0·5%; these tests therefore are being repeated during the current year—it is not possible yet to state how high the proportion of success will be, but it would appear that again a considerable quantity of fruit will be formed. In practice, the yield of seed was much reduced, for in the *Coffea robusta* there was a large proportion of pea berry, as in many fruits only one ovule developed. The seed was sown and the seedlings grown on in order that they may be planted in progeny rows.

5. *Introduction of New Varieties.*—During the year, two varieties of *Coffea arabica* were introduced—Harar, which originated in Abyssinia and which is one of the most outstanding types at the Scott Laboratories, Kenya, from whence seed was obtained; and Kent's Arabica, of which seed of the fifth generation plants was purchased from India. Some of this seed of both types was sown at Kampala, and the remainder was forwarded to the Agricultural Officer, Bugishu, for trial there. During March we received a visit from Dr. Cramer, whose work on coffee in the Dutch East Indies is so important, and who kindly arranged an exchange of seed of various selected types. In August there were received from Java seed of five *Coffea robusta* selections and one *Coffea excelsa* selection; the seed was sown on arrival, but the germination was poor.

B. VEGETATIVE PROPAGATION.

6. *Grafted Coffee.*—In the annual report for the year 1933 reference was made to the difficulties which have been found to be involved in the cultivation of grafted coffee in Java, where this problem has been studied on a large scale. In other countries it has been claimed that by grafting coffee arabica on a strong growing stock resistance to leaf disease might be induced, but, as was mentioned in the last report, the grafted trees at Kampala have shown themselves definitely to be more susceptible to Leaf Disease (*Hemileia vastatrix*) than have the seedling trees on the plantation. The grafted clones (9 trees of each) were planted out in 1932; as the trees are of various ages, it is not possible to give figures which would be strictly comparable, but, as a general rule, it may be stated that with both the *C. arabica* and the *C. robusta* scions, the growth has been more vigorous on *C. robusta* stocks than on those of *C. excelsa* or *C. liberica*. However, there has been a serious complication, for during the year many of the stronger and more heavily cropping trees have suddenly died. At the end of 1933 two grafted *C. arabica* trees went off; in June several more *C. arabica* looked very unhealthy and some of them died; later in the year some of the *C. robusta* also succumbed. Specimens were forwarded to the Mycologist, who found traces of fungi on the roots; but he considered that these fungi were secondary, and that the primary cause of the trouble was either due to the insect attack of the bark at the point of union between the stock and the scion, or to incompatibility of the stock and the scion.

The striking feature of the phenomenon was the fact that usually it was the most vigorous trees of any one clone which suffered, *e.g.*, of eight trees of clone S101 (*C. arabica*) the heights (in cms.) in February, 1933 were 75, 175, 92, 131, 172, 77, 154, and of these at the end of the year the tallest was nearly dead and the second tallest was quite dead. Similarly of the clone S43 (*C. robusta*), whose heights were (in cms.) 82, 71, 95, 150, 139, 153, 115, 104, 142, the four tallest ones died during the year. It is contrary to the general experience that termites should attack only the most vigorous of a batch of trees, and examination of the trees *in situ* would appear to show that the termite attacks are largely secondary, and that it is the incompatibility of stock and scion which really has caused the death of the trees. The Plant Physiologist at Amani has shown that in ordinary seedling trees of coffee arabica, the production of a heavy crop of fruit causes considerable depletion of the carbohydrates in the plant and that, if overbearing takes place, die-back of the shoots and of the roots is caused. It would seem probable that the death of the grafted trees has been due to a similar reason—that the incomplete union between the bark of the stock and the scion has hindered the movement of carbohydrates down to the roots, and that when the tree has been bearing a good crop, the roots have died from starvation. This hypothesis is supported by two facts:—

(*a*) that on trees which have recently died, the bark of the scion down to the point of union has been thick and firm, while that of the stock below has been thin and flaky.

(*b*) that while there has been vigorous root growth on healthy trees, on those which have been checked by heavy fruiting, very few young roots have been formed, and that such roots are much thinner than are the normal turgid white roots of coffee trees.

7. *Cuttings.*—Considerable attention was devoted to trials of propagation of coffee by cuttings. In April there were inserted in the solar propagator three batches of 10 cuttings of different types of wood of both *C. arabica* and *C. robusta*. The types of wood used were:—

(*a*) Very soft wood with a heel.

(*b*) Firmer wood without a heel, with the bark starting to crack.

(*c*) Still firmer wood on which the bark had cracked.

Many of the cuttings produced shoots several inches in length, bearing leaves which remained green for several months before they died; when such cuttings were examined it was found that usually there had been varying growths of callus at the bottom and at places where laterals were removed (sometimes only in the latter position), but that no actual roots were formed. Only in two cases did the cuttings actually root—one of each of the firmest types (*c*) of *C. arabica* and *C. robusta* have rooted. In 1933 a similar cutting of *C. robusta* was rooted in the frame—the cutting was planted out and has made growth comparable to that of a seedling of the same age.

At the same time that the cuttings were put in the frame, batches of 12 cuttings of still harder wood of each of *C. arabica* and *C. robusta* were inserted in nursery beds; these cuttings were about 2 feet long and about $\frac{1}{2}$-inch to $\frac{3}{4}$-inch diameter at the base—the bark was commencing to turn grey. Again many cuttings, without rooting, produced shoots of considerable length—up to 6 inches, and the only cuttings which did root were 4 (*i.e.*, a third) of those of *C. robusta*. Further trials on a larger scale of hard wood cuttings of both *C. arabica* and *C. robusta* were made in August; by the end of the year many of these cuttings had produced shoots, but it was not possible to state whether they would form roots.

C. EXPERIMENTS RELATING TO GROWTH.

8. *Soil Treatment and Coffee Growth Experiment.*—This experiment, which is being carried on in collaboration with the Chemical Section, was described in the annual report for 1933. The measurements of shoot and leaf growth, and the observations on root growth are being continued. Differences in the appearance of the Robusta coffee trees according to their treatment are now obvious; the plots which are clean weeded and mulched show vigorous growth and healthy foliage, while the plots on which the weeds are slashed and that under cover crop show the yellowish leaves, the short primaries and the bare stems which are so typical of unhealthy Robusta coffee. Daily records of the soil temperatures are being kept and are yielding interesting results. In Graph 1 there are shown the weekly maxima recorded at a depth of two inches at 3-30 p.m. The value of mulching and of shade in preventing excessive soil temperature is clearly shown; throughout the experiment, the maxima on the shaded plot are very low, and the only time when high maxima were recorded on the mulched plot was in October, when the cover had become thin—when the mulch was renewed in November, the temperature fell. At the beginning of the year, when the cover crop (*Centrosema pubescens*) was young, high maxima were recorded, but at the end of the year a thick cover had been formed and the temperatures were lower. Researches into the physiology of temperate plants has shown that temperatures exceeding 30°C—35°C are inimical to root growth. Coffee is a tropical plant, but it is almost certain that prolonged exposure of the roots to temperatures above 35°C must upset their metabolism. It would seem possible that excessive soil temperature may be an important factor in the "die-back" of coffee; the value of mulching in curing this condition is well known, and the disease is rarely, if ever, seen in coffee growing under shade. It does not follow that the shading of coffee is to be advised, for although such a procedure may have other beneficial results, for example, in the suppression of the growth of harmful weeds and especially of grasses, yet it often encourages harmful insects. The use of a soil mulch is not subject to this drawback, and it has an almost equal value in preventing undue heating of the soil.

9. *Growth of Seedlings.*—It is common knowledge that coffee seedlings, when they are pricked out in the nursery bed, do not grow well if they are unshaded. It has been suggested that if the ground is kept cool and moist by mulching, the growth of the seedlings will be satisfactory. In order to test this point, batches of fifty seedlings were put out in February in beds subjected to different treatments:—

(*a*) Shaded.

(*b*) Not shaded.

(*c*) Not shaded, but the ground mulched.

Three types of seedlings were used—Arabica, Robusta 2 (erect type) and Robusta 209 (spreading type). The seedlings were dug up in June; in some cases, owing to the attacks of crickets, there were many blanks, and therefore at the end samples of thirty five of each

batch were weighed and measured. Owing to my absence on leave, the Chemical Section kindly assisted with this work. The results were as follows:—

TABLE II.—AVERAGE MEASUREMENTS AND WEIGHTS OF SEEDLINGS.

Type of coffee.	Shaded plot.	Non-shaded plot.	Mulched plot.
Arabica:—			
Height of plant	16·8 cms.	13·8 cms.	13·5 cms.
Length of root	16·8 cms.	17·7 cms.	14·7 cms.
Weight of shoot	0·93 gms.	0·87 gms.	0·51 gms.
Weight of root	0·46 gms.	0·32 gms.	0·30 gms.
Total weight	1·39 gms.	1·19 gms.	0·81 gms.
Robusta 2 (*erect*):—			
Height of plant	14·8 cms.	13·8 cms.	13·3 cms.
Length of root	16·7 cms.	17·7 cms.	17·0 cms.
Weight of shoot	1·30 gms.	0·87 gms.	0·76 gms.
Weight of root	0·66 gms.	0·41 gms.	0·41 gms.
Total weight	1·96 gms.	1·28 gms.	1·17 gms.
Robusta 209 (*spreading*):—			
Height of plant	11·7 cms.	12·1 cms.	10·9 cms.
Length of root	12·6 cms.	14·4 cms.	12·6 cms.
Weight of shoot	0·67 gms.	0·61 gms.	0·41 gms.
Weight of root	0·39 gms.	0·32 gms.	0·26 gms.
Total weight	1·06 gms.	0·93 gms.	0·67 gms.

It will be seen that with every type the heaviest seedlings were those which had been grown in shaded beds, and that the mulch had no beneficial effect—the seedlings to which it had been applied were lighter than those grown in unshaded ground.

D. LIQUORING TESTS.

10. *The Effect of Methods of Preparation.*—Somewhat contradictory reports were received in 1933 on the relative values of coffee prepared in different ways, therefore the experiments were repeated. In January there were carefully prepared eight samples—

A. No. 9 Robusta. Pulped, fermented for 24 hours, washed and dried.
B. No. 9 Robusta. Pulped, fermented for 36 hours, washed and dried.
C. No. 9 Robusta. Sundried in the cherry and hulled.
D. No. 9 Robusta. Ripe cherry stored in tins for 4 days, then sundried and hulled.
E. Nganda Robusta. Pulped, fermented for 24 hours, washed and dried.
F. Nganda Robusta. Pulped, fermented for 36 hours, washed and dried.
G. Nganda Robusta. Sundried in the cherry and hulled.
H. Nganda Robusta. Ripe cherry stored in tins for 4 days, then sundried and hulled.

Through the courtesy of Messrs. Baumann & Co., and Buchanan's (Uganda) Estates, these samples were submitted to brokers in Nairobi and New York. The report received from Nairobi was as follows:—

"*Green.*—

A. The best all round, being greenish in colour and regular in size.
F. This is a close second but is not so regular in appearance.
B. Quite a good coffee but spoiled by brown beans being mixed with it.

Roast.—

A. The best, being even and regular in size.
B., *C.*, *D.*, *E.*, *H.* All fairly good roasts.
F., *G.* Fair roasts.

Cup.—

In order of merit.
A. 1.
B. 2.
E., *F.* 3.
H. 4.
C. 5.
D. 6.
G. Nasty."

The following are extracts from the report from New York:—

"With their tester, our coffee broker and the writer saw the samples weighed, ground and "cupped" and it is the unaminous opinion that your sample *D* will best suit our demand and would find a very ready market here. As a matter of fact all

these samples have the same general character, in the same way that all Java Robustas have the same general character, but there is quite a wide difference in the different types of each and all would be saleable on this market except *G* as roasted . . . . It was the opinion that properly prepared such washed coffees (*A*, *B*, *E*, *F*) would have a market value of about ¼ cent (one-eighth penny) above the other samples . . . . Sample *C* also was liked and at one time it appeared that it might have more of the distinct suggestion of the Java Robusta, but this did not appear to hold out and the sample *D* was preferred and selected as the most desirable of the samples."

Again, the reports are contradictory: both reports condemn sample *G*, yet samples *D* and *C*, which in the Nairobi report were placed next to the bottom, are those which are preferred in the American market. One fact does appear to be established, that the advantage of pulping, fermenting and washing Robusta Coffee over the preparation by sundrying and hulling lies not in the fact that it improves the cup quality, but in the superior appearance of the final product: this is an important consideration, for it is on the basis of appearance that Robusta Coffees mainly are valued.

Tea.

11. *Seed Supply.*—Owing to the interest in tea planting that is being displayed in Uganda, the question of seed supply received considerable attention. Early in the year a visit was paid to the seed garden of Kalline Manipuri Tea at Buwunga, near Masaka, and further rogueing of undesirable trees was carried out. The plot of Assam Indigenous tea at Kakumiro also was thinned to form a seed garden. At the Botanic Gardens, Entebbe, in March there was planted an isolated plot of Betjan Assam tea, which is intended for seed production, the plants being spaced 15 feet apart, triangular planting. Growth has been somewhat irregular, and there have been a few failures. In April a similar plot of Dhonjan tea was made at Kitabi, near Entebbe. Owing to unfavourable weather conditions subsequent to the planting, few trees on this plot have made strong growth and several have died. A number of seedlings of Dangri Manipuri were supplied to the Senior Botanist for the establishment of a seed garden of this jat at Bukalasa.

12. *Germination Tests.*—In February, May, August and November batches of seed from the Assam Indigenous jat on Plot 32, Kampala Plantation, were sown in boxes of sand to test their germinating capacity. The seed was thrown into water and that which floated was separated from that which sank, as is the usual custom when seed is supplied for planting. Both "floaters" and "sinkers" were divided into large seeds and small seeds, and 200 of each of the four types were sown separately. The percentage of germination was as follows:—

Table III.—Percentage of Germination of Tea Seed.

Type of Seed.	February.	May.	August.	November.	Average.
Large floaters ...	33·0	44·5	71·5	58·0	51·75
Small „ ...	16·5	63·5	57·5	54·0	47·875
Large sinkers ...	89·0	99·5	100·0	96·5	96·25
Small „ ...	84·5	99·5	98·5	90·5	93·25
Average ...	55·75	76·75	81·875	74·75	72·28

These figures show that if the floating seeds are discarded, most of the bad seed is removed, but that also there are lost many seeds which would germinate, and when seed is urgently needed, that such separation is wasteful. The variation in the percentage of germination at different seasons is interesting, and it is hoped that this point may be investigated further. It was noted during the course of these trials that the small seeds germinated more rapidly than the large seeds.

13. *Self-Pollination.*—In January five branches of the seed bearing trees on Plot 32, Kampala Plantation, were enclosed in sleeves of mosquito netting, and the flowers, as they opened, were self-pollinated with a camel hair brush. But it would seem that this procedure will be of little commercial value, owing to certain difficulties: firstly, that there is no sudden flush of flowering as in the case of coffee—although the sleeves were kept on the branches from January until July, a total of only 200 flowers opened; secondly, of the 200 flowers that were self-pollinated, only one formed a fruit—this contained two seeds which when planted produced seedlings of no special merit.

Essential Oil Plants.

14. *Pelargonium* spp.—As satisfactory reports have been received on the oil from *P. radula*, it was decided that a considerable area should be planted up with this type, in order that figures of yields and costs of this crop might be obtained. A considerable amount of time was devoted to the work of propagation. Cuttings placed in the open ground failed to root, while the percentage of success with those placed in boxes of sand varied greatly, but by the end of the year 1,200 plants were established. In October a preliminary cutting and distillation of *Pelargonium pinnatum* was made. In January cuttings of 11 types of *Pelargonium* were received from the Scott Laboratories, Nairobi, but almost all of them failed to root: in November, a plant of a superior strain of *Pelargonium radula* was imported from Kew and it is now being propagated.

15. *Lippia citriodora* (*Lemon Verbena*).—A favourable report was received on samples of oil sent to England by the Agricultural Chemist, therefore the propagation of this plant was continued as material became available and the area of the plot was increased.

16. *Pogostemon patchouli* (*Patchouly*).—Propagation of the new type, imported from Singapore in 1933, was continued and by the end of the year four small plots were established on the Kampala Plantation. At first the plants grew well, but later several appeared to be unhealthy; material was sent to the Mycologist, who reported that the plants were attacked by a species of Pythium.

17. *Other Essential Oil Plants.*—Propagation and planting of *Lavendula dentata* and *Rosmarinus officinalis* was continued. It was decided in September to discard other crops, which had been found to be of little economic value, anl merely to retain small quantities for reference purposes. These crops were:—

Pelargonium odoratissimum.
Pelargonium (Attar of Roses), varieties *A* and *B*.
Lavendula spica (Lavender).
Polianthes tuberosa (Tuberose).
Coleus spp.
Hoslundia opposita.
Pogostemon patchouli (Ceylon variety).
Mentha spp. (of which twelve outstanding types are imported, and are being grown under observation).

Seed of *Canangium odoratum*, a tree whose flowers are distilled to yield Ylang-Ylang oil, was introduced from Singapore and germinated satisfactorily.

Fixed Oil Plants.

18. *Elaeis guineensis* (Oil Palm).—Work on this crop was continued at the Botanic Gardens, Entebbe. The area under oil palms was increased considerably by planting out the seedlings raised from seed imported from Nigeria in 1931, and rows of the progeny of our heaviest yielding palms. The investigation of the fruit and kernel size of the best palms was commenced.

19. *Aleurites* spp. (Tung Oil).—The plants of *Aleurites Fordii* and *A. montana*, planted at Kampala in 1930, continue to be stunted—most of them have died back and are sending out new shoots from near ground level. It would seem that these plants will be of no value in the warmer parts of Uganda.

20. *Ricinus communis* (Castor Oil).—The progeny rows of selections from local types, sown in November, 1933, commenced to flower in January, and produced a first crop between February and June. Some types produced a second crop later in the year, others died out. Progeny rows of the four plants which bore the heaviest first crop were sown in August, and were commencing to fruit by the end of the year.

Fibres.

21. *Corchorus capsularis* (Jute).—This crop was again tried at Kampala, but was even less successful than in former years. Seed was sown in March, and the blanks were resown in April, but the growth of the plants was very variable—most of them were very stunted and the average height was only about three feet. Many plants were diseased and the Mycologist reported that they were attacked by eelworm.

22. *Abroma augusta.*—This is a large subshrubby plant whose bark contains a strong white fibre, and which has received favourable reports in other countries. Seed was imported from the Belgian Congo, from Amani, and from Singapore. In no case was the percentage of

germination very high, even when the seed was sown in the greenhouse—when sown at stake in the open ground it failed almost completely. But by the end of the year batches of plants from all three sources were established in the open ground and were making rapid growth—the oldest were four feet high.

Spices and Condiments.

23. *Piper nigrum* (Black Pepper).—The seedlings which were planted out in 1933 at Kampala, all failed. Those planted at Entebbe are making good growth, but, owing to the overproduction of this crop in the east, it is doubtful whether the cultivation of pepper will ever be profitable in Uganda.

24. *Capsicum* sp. (Japanese Chillies).—Seed of two types, a large fruited and a small fruited, was obtained in England and was sown on the Kampala Plantation in August. The germination was not very good, but a quantity of plants were fruiting by the end of the year. There were forwarded to England four samples:—

A. Large fruited crimson.
B. Large fruited orange.
C. Small fruited crimson.
D. Small fruited orange.

(The difference in colour appeared to be due to the fact that samples *B* and *D* were of fruits which had been picked before they were absolutely ripe).

The reports received (in April, 1935) were as follows:—

1. "Samples marked *B* and *D* being a very yellowish colour are not wanted and and would be difficult to sell and are therefore almost impossible to value. Sample *A* is a good colour and should fetch 40/- to 45/-. Sample marked *C* is also a good colour worth 55/- or more. It is almost up to the standard of "Japanese No. 1 Birdseye" which is worth 60/- and is well known type and therefore easily marketable."

2. "*A* worth about 40/-, *B* 35/-, *C* 50/-, *D* 45/- . . . . . "

Drugs.

25. *Hydnocarpus* spp.—The plots of *Hydnocarpus Wightiana* at Kampala and at Entebbe continue to grow strongly and to fruit well. At both places *H. anthelmintica* has made strong growth—the trees are considerably taller than those of *H. Wightiana*. In both plots some trees are commencing to bear, but up to the present the production of fruit by *H. anthelmintica* has been very small in comparison with that by *H. Wightiana*.

26. *Chenopodium ambrosioides* var. *anthelminticum* (Wormseed).—In order to produce a bulk of material for distillation, large plots of this plant were sown twice, once in the early rains and once in the late rains, yet in both cases the attempt was almost a complete failure: the germination was poor and many of the seedlings died off, after reaching a height of about one foot. The cultivation of this plant will be studied again during the current year—it may be that it requires a very firm seedbed, for it has been noticed that while plants in cultivated ground are a failure, chance seedlings on paths will make vigorous growth.

Green Manures and Legumes.

27. *Crotalaria juncea* (Sunn Hemp).—Selection of this crop, with the intention of segregating a strain with more vigorous branching growth, was continued. Progeny rows of twenty selections, made in 1933, were sown in March. The plants were singled to a spacing of three feet by two feet: in May twenty plants were selected. Seed from these selections were sown in August, but plants did not grow so strongly as those planted during the early rains, and there was a considerable number which had a very branching habit, small leaves and abortive flowers—a condition which appears to be due to a virus disease. In November ten of the best plants on the plot were selected.

28. *Vigna unguiculata* (Cowpea).—At the request of the Economic Botanist, Royal Botanic Gardens, Kew, replies were forwarded to a questionnaire concerning the types of Cowpeas cultivated in Uganda.

There were sown on the Kampala Plantation rows of thirty types, forwarded by Agricultural Officers from West Nile, Lango, Toro, Mbale and by the Tobacco Officer from Bunyoro. Notes were made on the botanical characters of the plants, their liability to insect attack and fungus diseases, etc., and herbarium specimens were prepared. Unfortunately, owing to unfavourable weather, the growth of the plants was poor, but a considerable amount of information was amassed and forwarded to Kew.

Grasses.

28. Two additions were made to the collection of grasses grown on the Kampala Plantation—*Pennisetum polystachyon* from the Eastern Province and *P. Rupelli* from Amani.

Shade Trees.

29. During the year there were introduced four species which may be of value as shade trees in Uganda—*Albizzia procera* and *A. fastigiata* from the East African Agricultural Research Institute, Amani, and *Dalbergia Sissoo* and *D. latifolia* from the Forest Research Institute, Dehra Dun, India. Seed of the two latter species was forwarded to Toro for trial there.

Fruit Trees.

30. Several hundreds of Citrus seedlings, mostly Rough Lemon and Sour Orange, were planted out at Kampala and Entebbe and grown on to provide stocks on which to bud the improved varieties of Citrus fruits which have been imported in former years.

Introductions.

31. Among the economic plants imported during 1934 there may be mentioned:—

Harar Arabica Coffee from the Scott Laboratories, Nairobi: Kent's Arabica Coffee from T. P. Kent, Esq., Mudigere, India: Five selections of Robusta Coffee and one selection of Excelsa coffee from Tangjongdjati Estate, Kota-Agoeng, Sumatra.

Seed of *Abroma augusta*, *Albizzia procera*, *A. fastigiata* from the East African Agricultural Research Institute, Amani, Tanganyika Territory.

Seed of *Dalbergia Sissoo*, *D. latifolia* from the Forestry Research Institute, Dehra Dun. India.

Twelve varieties of mints from E. H. Metcalfe Esq., University of Reading, England.

Pelargonium radula, French variety, from the Royal Botanic Gardens, Kew.

Seed of *Abroma augusta* and of *Canangium odoratum* from the Botanic Gardens, Singapore, F.M.S.: and of the former from the Botanic Gardens, Eala, Belgian Congo.

Grateful acknowledgements are made to all those who have kindly presented plants and seeds and to those who have rendered assistance in the valuation of various products.

A. S. THOMAS,

Assistant Botanist.

PART V.—ANNUAL REPORT ON THE BOTANIC GARDENS, ENTEBBE.

Throughout the year the writer had general supervision of the Gardens subject to instructions from the Assistant Botanist. Being 25 miles distant, and no relief afforded during the period this officer was on leave, the time at my disposal for supervising the work very seldom exceeded more than one visit per week.

2. Meteorological.

As in 1933, the summaries for each month were furnished by courtesy of the British East African Meteorological Service, and thanks are due to the officer-in-charge of their station at Kampala for this service.

Upon referring to the summaries, an outstanding feature is the low rainfall of the year, 50·99 inches, a figure approximately 8·5 inches below the yearly average based on records during the past thirty-four years.

January proved to be the driest month of the year, 0·32 inches only being recorded, (2·47 inches below the monthly average), while May was the wettest month with 11·15 inches, equal to 1·73 above the monthly mean.

The highest fall of the year was 3·82 inches, and occurred on the 13th of May.

With regard to temperatures, the means of both maximum and minimum, 78·80° and 63·4° respectively, were very similar to those of several years past. The highest reading of the year was one of 87·00 degrees, recorded on 24th September, and the lowest 57·00° was registered on 11th July.

3. Labour.

An ample supply was available each month, but the standard proved to be poor generally. On this account some porters drawn from tribes in the West Nile and Chua Districts were employed, and these were found to be considerably more efficient where any new clearing work and subsequent preparation had to be done.

Wages varied little from those paid during the previous year, Shs. 12 being the general rate, with an increase of Shs. 1 or 2 after some service.

The attendance of all tribes was as a whole generally satisfactory.

4. Oil Palms (*Elæis guineensis*).

Records of individual tree yields have been continued from the established plot, so that progressive totals of the 105 palms forming this are now available for the last six years. Great variation has been observed, most noticeable is the fact that some palms have only very recently commenced to produce fruits while others have yielded a few hundred pounds. Palm No. 12 headed the list at the end of the year with 831½ lbs. to its credit.

New Development.—Adjoining the existing plot an area was opened up and eighty-eight seedlings set out during May and June, 30 feet apart, angular planting: Twenty-one of these are from imported seed received from Nigeria three years ago, the remainder raised from seed from eight highest yielders here at the time. Very wet weather set in soon after planting and the seedlings did not establish themselves so well as they might have done under more normal conditions.

Those of the imported strains on a slightly higher level have made most progress.

Investigation of Fruit and Kernel Size.—Data is being collected from twenty of the highest yielding trees. Taken at random, 200 fruits of each are being examined to obtain the information. Sixteen samples only so far obtained.

Distribution of Seeds and Seedlings.—Eight hundred seedlings and approximately 335 lbs. of seeds were sent to the Masaka District, and 200 seedlings to Serere Plantation, Teso.

5. Tea (*Thea sinensis*).

Two plots were established during the year, one within the Botanic Gardens area, the other at Kitabe, approximately 1½ miles away. The plants used to furnish these have been raised from seed which was received from India during 1932 under the names of Bet-jan and Dhon-jan respectively; both are types of Assam Indigenous tea. They are to act as seed bearers in due course.

Progress of both strains has been slow, and only in a few isolated cases has any substantial headway been made. Much is attributed to the stunted nature of the plants at the time of transfer from plots to the open ground.

A semi-permanent shade is being used by the interplanting of "Mubimba" (*Sesbania aegyptica*), also use is being made of strips of "Lemon Grass" (*Cymbopogon citratus*) to prevent soil erosion in the early stages, these being planted across the slopes.

6. *Hydnocarpus Wightiana* and *H. anthelmintica.*

H. Wightiana.—More than fifty per cent. of the thirty-six trees which form the plot have now proved to be males. One tree succumbed to "wet root rot" (*Armillaria mellea*) during the year and a neighbouring tree taken on a sickly appearance since, otherwise much growth of somewhat bushy habit has been made. Many trees are about 15 feet in height and about the same distance through.

A small first crop of fruits ripened and harvesting straggled over most of the year. These fruits were generally inclined to be of small size and contained on the average 10·7 seeds only. Very immature second and third crops were in evidence at the end of December.

H. anthelmintica.—This species has made upward rather than lateral growth, somewhat in contrast to *H. Wightiana.* Owing to this it has not been able to fully ascertain the number of each sex, but it is assumed that male trees will again be dominant.

A very small crop of fruits ripened prior to September. These as a rule were somewhat larger than those of the previous species, and contained an average of 30·1 seeds per fruit.

Samples of seeds of both the above species have been handed over to the medical department for obtaining reports.

7. Pepper (*Piper nigrum*).

Vines of the above, supported upon mature Para rubber trees, have generally grown well. Now between 2½ and 3 years old, some have attained a height of about 18 feet, and in several cases possess many main stems.

Flowering commenced during June, but no fruits are expected from these as the plants have not yet reached the normal fruiting age.

8. Allspice (*Pimenta officinalis*).

Seedlings raised from seed received under the above name have since proved to belong to quite a different family and have been discarded.

9. Fruit Trees.

Additions made during the year to the newly formed plot include one Jak fruit (*Artocarpus integrifolia*), 1 Pecan nut (*Carya oliviformis*) transferred from the Kampala Plantation, 1 quince (*Cydonia vulgaris*), 1 *Cydonia japonica*, 1 Carambola (*Averrhoa Carambola*), 1 Avocado pear (*Persea gratissima*), purple skin var., 1 *Passiflora edulis*, improved var., 1 *Passiflora laurifolia*, papaw (*Carica papaya*), groups of two types originally from Panama, and 1 *Prunus Capuli.* Two attempts were also made to establish *Tacsonia, Van Volxemii*, but both failed.

The following died out during the year: 1 *Dillenia indica*, 1 Pecan nut, and 1 blood orange.

Grassing of the plot with *Paspalum notatum* is in progress but is somewhat retarded on the one portion until some improvement has been made to the township drain which cuts the plot. Owing to the inadequacy of this drain considerable damage was done during the year, a loss of several hundred tons of soil was washed from the fruit plots, and a huge quantity of gravel and stone work from near-by roads and drains was swept away by overflows of storm water.

10. Nursery.

Towards the end of April a start was made with stocking up the new nursery, and the gradual abandonment of the old area which eventually will be put under short grass. A system has been adopted whereby plants are grouped alphabetically in sections, *i.e.*, shrubs, climbers, fruit, etc., with amounts of each based on past seasons demands. Certain types may occupy as little as three feet while others may demand as much as a fifty feet length in the beds. During the past season the advantage of this system has not been felt to the fullest extent on account of the carry over of stocks from the old nursery, but henceforth there should be a very definite saving of time.

One half of the nursery is under fallow and was planted with Sunn Hemp (*Crotalaria juncea*) to cover the soil. At the bottom of this, sufficient room has been left to accommodate between 500—600 rough lemon and sour orange seedlings for budding purposes early on in the coming year.

Within the hedge of Mauritius Thorn (*Caesalpinia sepiaria*) which surrounds the whole, a two-strand barbed wire fence was intertwined, and a strong entrance gate erected to reduce the number of thefts.

The immediate surroundings also received some attention in the way of clearing, and a plot of about 2,700 "Nsambya" (*Markhamia platycalyx*) seedlings established. It isint ended to utilise these eventually for building purposes, erecting shade over the nursery beds, and such like.

11. Distribution of Plants and Seeds.

The total distribution which occurred during the year is follows:—

	Plants.	*Seeds (packets).*	*Bundles.*
Economic	3,216 ...	... 15 ...	... —
	5,221 ...	... 82 ...	... 9
	8,437 ...	... 97 ...	... 9

The month of April with the free distribution scheme in operation was easily the busiest with regard to the issue of plants and seeds; 2,431 economic plants and 12 packets of seeds of such were issued plus 806 plants and 2 packets of seeds of decorative plants.

12. Decorative Plants.

Many of the previous seasons introductions attained a suitable size to plant out. This was done grouping them in their respective families as far as possible.

The number thus treated was a large one and is therefore impossible to include fully in this report, so mention is merely made of some which flowered and certainly appear worthy of introduction.

Most handsome were the following three members of *Bignoniaceae, Tecoma Brycei, T. Mackenii, Bignonia Chamberlayni.* Others which did well were *Cestrum coccineum, C. cyanea, Streptosolen jamesoni, Hebeclinium ianthemum, Cuphea* sp. *Pynostachys thrysiflora* and *Canna iridiflora Ehmanii. Lavendula dentata* should also be included, but this did much better on the Kampala Plantation than at Entebbe.

13. New Introductions.

One-hundred-and-forty species of decorative plants were introduced during the year plus a number of others of a miscellaneous nature, some being of economic value.

These were obtained monthly from territories offering exchange lists of plants and seeds, one large consignment of plants and orchids were received from the Royal Botanic Gardens, Kew, a collection of succulent plants came from the University Botanic Gardens, Cambridge, and a few species were purchased from the Closeburn Nurseries, Nairobi, Kenya.

Here I wish to take the opportunity to express grateful thanks to those in charge of the various stations who responded so generally to our requests.

14. Fernery.

Within the older area little alteration was made, any work undertaken was mainly that of routine, *i.e.*, some local weeding, much clearing away of fallen leaves and the eradication of a good deal of pink flowering Lantana (*Lantana camara*) and *Aristolochia* sp. from places where these were rapidly approaching the pest stage. Two untidy corners were cleared, one was planted with *Mussaenda arcuata* and *M. luteola,* and the other with various species of *Ipomoea.*

The land on the eastern side, however, received a good deal of attention, and a new area was opened up to accommodate plants requiring partially shady conditions. Planted out in this were *Brownea* sp., *Cestrum aurantiacum, C. coccineum, C. cyanea* (*Iochroma cyanea*), *Ceanothus azeureus, Clematis Armandii, C. montana, Callodendron capensis, Caryopteris mastacanthus, Fuchsia macrostema gracilis, F. corymbiflora, Fuchsia* var. Ensign, *Gardenia florida, G. globosa, Hypericum canariense, H. lanceolatum, Holmskioldia sanguinea, Hebeclinium ianthemum, Indigofera roseo-caerulea, Ligustrum lucidum, Pycnostachys thrysiflora, Ruttya* sp., and three species of *Labiatae* originating from the lower slopes of Mount Elgon. With a few exceptions most of the above have established themselves, several producing flowers.

Nearby, the border devoted to bulbs, also members of both the *Scitamineae* and *Zingiberaceae* and closely allied families, was increased by the planting of *Alpinia nutans, Canna iridiflora* var., *Ehmanii*; Arrowroot (*Maranta arundinacea*) Cardomum (*Elettaria cardamomum*), Ginger (*Zingiber officinale*) and Tumeric (*Curcuma domestica*). Across the road *Iris japonica* has become successfully established.

15. Lawns.

It was not possible to give much attention to existing areas other than the usual routine work of keeping the grass short with hand mowing machines, five of these being in almost continual use. On the other hand a good deal of work preparatory to putting a number of new areas under grass was done, the Hydnocarpus, Conifer, fruit plots, old nursery area, and part of the old Canna border near the cocoa plot received attention in this way.

The plots of various grasses put down to test their suitability as lawn grasses were kept going, and of these *Paspalum notatum* and *Brachiaria decumbens* at the moment look the more promising.

16. Roads and Drains.

Much labour has again been expended throughout the year on the work of upkeep, less on the actual roads themselves but more on deepening the existing drains alongside, and facing the sides with large lumps of iron stone.

At the end of the year much stilll remained to be done, and it is foreshadowed that a gang will be constantly employed on similar work during the greater part of 1935.

17. New Development.

Early on in the year it was considered necessary to provide for the removal of some genera from the present rockery to a larger site selected in a hollow not far from the Secretariat, between the block of Para rubber and the Lake, and which would be suitable for this purpose as many small outcrops of ironstone appear naturally. Such a procedure has become necessary due to the increasing number of succulent plants which are being introduced.

It is proposed to devote the more rocky portion of the new clearing almost entirely to aloes and Euphorbias, and to reserve the lower part for some of the more conspicuous indigenous plants. We are indebted to the District Commissioner, Entebbe, for some assistance with the clearing and preliminary preparations of this new area.

18. Flower Show at Entebbe.

This was held at the Club, Entebbe, on May 19th, a good representative collection of local material being staged. The Botanic Gardens Department assisted after very short notice by exhibiting cut flowers and ferns, also supplying a number of palms to brighten odd corners.

Twelve less common plants such as *Petrea volubilis*, Bougainvillea, var. Mrs. Butt, *Lavendula dentata*, etc., were also provided and given as prizes by the Committee.

P. CHANDLER,

Plantation Manager.

REPORT OF THE GOVERNMENT ENTOMOLOGIST FOR 1934.

As the field entomological enquiry extends, a correspondingly greater proportion of the time of the officer in charge of the section has to be devoted to what may be termed administrative work, and these duties often, for considerable periods, monopolise the attention of one man to the complete exclusion of direct entomological work.

The report on work of medical interest will, as usual, be included in the Annual Report of the Medical Department.

Instructions were received to investigate the relative resistance of cotton varieties to Jassid bugs. Before deciding on the value of Jassid-resistant strains it was considered advisable to determine what, if any, damage these insects cause in Uganda.

For this purpose a number of observations were made with special reference to Jassid population and reddening of the edges of the cotton leaves. It is well known that older cotton tends to be redder and to have a higher Jassid population. Cotton grown on a dry hillside has, in past years, been proved to have a higher Jassid population and a more extensive reddening of the leaf. Varieties with leaves which redden easily support, in many cases, a higher Jassid population. In dry country Jassids are often numerous and the leaves of the cotton are often bright red. Despite numerous thorough observations by the Entomological Section which have invariably revealed some alternative possible reason for the failure of the cotton, it has been asserted that the common simple correlation between leaf reddening and Jassid ***must*** prove that these bugs are a major pest.

One of the series of observations made during the past season consisted of a traverse in one day from northern to southern Busoga. Jassid nymphs were counted on ten leaves of each of ten plants chosen at random in each plot and the average number of Jassids per *plant* (*i.e.*, ten leaves) was noted. In Northern Busoga the leaves were bright red, at least at their edges, and conditions were dry. Over the remaining part of the traverse there was little indication of reddening of the leaves except on a few plots at Wanyange, where a trace of reddening could be found.

In northern and central Busoga the Jassid counts varied from 0—1·0, the bright red plots showing no higher counts. At Wanyange the prevalence on some of the plots was somewhat higher, S.G. 23/8 in the "Soil-Climate-Insect" series reaching a maximum of 2·9. This was the highest of all the "S.C.I." plots in the Eastern Province except for one of the Jassid-resistant S.P. 13 which at Aduku was 3·1. It is clear that the number of Jassids found during this survey was negligible. A few sub-plots of the variety trials in the Eastern Province showed a maximum Jassid population of seven during December (near the end of the season).

A further attempt was made to ascertain the correlation between Jassids and reddening on the large sowing-date and spacing variety trial plot at Serere. This was done by counting Jassid population and by making counts (on a system of marking of 1—10) of the amount of reddening. The figures were handed to the Mycologist for analysis and his conclusions were:—

(1) The plants of earlier sowing dates showed a higher Jassid population and more reddening than those of later sowing dates, those of April having more than May, and May more than June.

(2) The Nyasaland varieties have more Jassids and more reddening than the U. 4 derivatives: S.P. 72 > S.G. 29 >>>> S.P. 1 > S.P. 20 = S.P. 48 > S.P. 21.

(3) As the plants grow older the relative differences in population and reddening between S.P. 72, S.G. 29, and U. 4 derivatives (in descending order) are accentuated.

(4) There is a positive correlation between Jassid population and reddening.

(5) After eliminating the effects of sowing-date and variety and their interactions there is no correlation between Jassid and reddening, *i.e.*, Jassids are assocated with reddening but are not the cause of it. (This result should be read in conjuniction with the observation of Lygus damage and of the attack of *Bacterium malvacearum* on this plot and on the district variety trials because most of the varieties which have more reddening and a slightly higher Jassid population are those which are susceptible to attack by one or both of these.)

The evidence shows that there can be:—

(*a*) intense reddening in the absence of Jassid bugs, giving no apparent correlation;

(*b*) an apparent though false correlation.

It proved necessary therefore to consider true Jassid damage and its effect on the crop.

In only one instance during the past season was true Jassid reddening observed. On the flats near Lake Albert a plot was found to be attacked by three species of Jassid bugs—*Empoasca facialis*, Jac., *E. benedettoi*, Paoli, and a larger green species; *E. benedettoi* was

apparently the commonest and *E. facialis* the rarest. The cotton was growing in good soil, showing a high field phosphate test, and had a good water supply. The variety grown was S.G. 29 imported from Teso; the crop was exceptionally good and the Jassid count was 17·5 nymphs per 10 leaves (*i.e.*, per plant) at the time of the observation (October 17th). The plot was visited again on 16th December to see whether the crop was likely to be shed and it was found still to be in excellent condition; the Jassid population, determined from an unusually large sample, had fallen to 8·0. The reddening of the leaves in this instance was clearly due to Jassids and there was no drought effect.

On lighter soil at Butiaba the effects of drought and Jassid bugs were combined, the environment being much the same as in northern Busoga. The crop was considerably less than that on the plot mentioned above and drought conditions prevailed; the leaves of the plants were completely covered with the webs of a minute red mite. In this instance also there was no evidence of Jassid damage.

It is therefore concluded that there is no evidence that either *E. facialis* or other species of Jassidæ showed any indication during the past season of being a pest.

Examination of the "Soil-Insect-Climate" plots of cotton (including the delicate S.G. 23/8) at Rhino Camp (at much the same altitude as Butiaba) proved impossible. Routine counts were, however, carried out on the other "S.C.I." plots towards the end of the season, Jassids being absent during earlier growth. The results obtained from Jassid counts at 16 centres gave the populations for the several varieties as below:—

Variety.	Average.	Lowest.	Highest.
S.G. 23/8 ...	... 1·67 ...	... 0·4 ...	... 2·9
S.G. 29 ...	... 1·50 ...	... 0·5 ...	... 2·6
S.P. 13 ...	... 1·74 ...	... 0·5 ...	... 3·1

These figures show no indication of any high Jassid infestation.

The Jassid populations on plants in the variety trials were estimated but they never reached a high figure. The U. 4 derivatives showed a lower population of Jassids (and of most other insects) than the Nyasaland strains. (Counts were also made on the pedigree lines at Serere for the Assistant Botanist.)

Comparing the Uganda figures for S.G. 23/8 with South African figures for Jassid populations:

S.G. 23/8 (mean of plots at at 16 centres), 1·7.

South African resistant varieties, 1·0—28·0 (1·0—3·0 early in season); (mean of best varieties 3·0, rising to about 12·0.)

South African susceptible varieties, 33—81: (most susceptible varieties varying from 50 to 100.)

(From E.C.G.C. Reports from Experiment Stations, 1925—26, p. 40, and 1927—28, table 1, p. 57.)

The evidence indicates that Jassid infestation in Uganda, at least during the past season, has been negligible and that until the population of this bug rises to well over 20, damage by these insects is of no practical importance.

The demands for work on other cotton insects caused virtual suspension of the investigation of Pink Bollworm. A proposal was made for a test of the effect of fermentation of cotton seed in bulk on survival of resting larvae of *Platyedra* but the lack of seed with a sufficiently high infestation caused abandonment of the experiment.

The season 1933-34 was unusually dry and it was suspected that if resting larvae were to occur at all in Uganda, the abnormal climatic conditions would cause this phenomenen during 1934. This surmise proved correct.

The Tobacco Officer kindly supervised the observance of emergence of *Platyedra* moths from infested seed kept at Hoima, and similar observations were made at Kiboga and Kampala. Emergences from resting larvæ collected at Kiboga in 1933 and kept at Kampala occurred during 1934 and the data obtained proved that Pink Bollworm larvæ may rest in Uganda for at least seven months. The number of resting larvæ was insufficient to base conclusions on with regard to effects of weather, and additional observations will be necessary.

The subject of alternative food-plants of Pink Bollworm was investigated as opportunities occurred. A patch of grassland with much *Hibiscus cannabinus*, which had escaped the annual burning, growing in close proximity to heavily infested cotton plots, was sampled on three occasions before July; no larvæ of *P. gossypiella* were found but the last sampling yielded larvæ of *P. erebodoxa*. These larvæ were kept but most of them failed to mature; in view of the more recently discovered variation in larvæ of *P. gossypiella* this was particularly unfortunate since some of these may have been mixed with those of *P. erebodoxa*. A clump of *H. rostellatus*, also near a heavily infested cotton plot, was likewise sampled and yielded only larvæ indistinguishable from *P. erebodoxa*. An insignificant number of negative records were also obtained from *Hibiscus* sp. near *calyphyllus*. In the light of the recent developments in the systematics of *Platyedra* it would seem inadvisable to assume that no Pink Bollworm were present among the larvæ obtained from *Hibiscus* spp.

Field observations on plants of the "S.-C.-I." cotton plots revealed no serious attack by Pink Bollworm, and on Mr. Hancock's transfer to the Education Department, at the time when resting larvæ were likely to occur, the work had to be discontinued. As mentioned when considering Jassid bugs, it proved impossible to make observations on the plots at Rhino Camp, which were grown especially to determine if resting occurred in that climate and in any of the varieties.

Towards the end of the 1934—1935 cotton season, a considerable number of cotton boll samples were obtained and examined to determine the limits of the infestation by Pink Bollworm. The areas free from this pest appear now to be reduced (approximately) in the east to the districts bounded by the River Nile, Longitude 33° East and Latitude 2° North, and in the south to the part south of Latitude 0° 20′ South.

An experiment to test the effects of hand-collection of *Dysdercus* on quality of cotton was abandoned owing to the low incidence of this bug. It was interesting to note that while a plot of more dense growth about a mile distant was infested to a moderate degree by stainers, the insects did not migrate from it to the somewhat drier plot of the experiment.

To determine whether there was any difference between the amount of stained cotton near ginneries which were heavily infested with stainers and near those not infested, a set of observations on a restricted scale were made, with the following results:

Clean and infested ginneries—12·45% and 16·4% stained locks respectively. (Difference not significant).

The factors influencing the extent of damage caused by stainers are:—

(*a*) The number of stainers (*Dysdercus* or other large bugs).

(*b*) The climate in so far as rain will assist bacteria to enter bolls through stainer punctures. (In two places under the same climatic conditions this will apparently be directly proportional to numbers of stainers).

(*c*) The number of infected stainers; (in this case a fungal disease is involved and damage varies with (1) total population (2) the numbers infected: a large uninfected stainer population in itself has no influence on this type of stain, but staining will increase as the bugs' infectivity increases).

For these reasons the total stained cotton may or may not be more near to any infested ginnery than any clean one. The seed dump at a ginnery will increase the percentage of infected stainers and the stainer population by more or by less than the proximity of, for example, a piece of forest fringed with *Hibiscus*. It cannot therefore with truth be asserted that because extensive staining (from a variety of causes) can occur far from ginneries stainers at ginneries need not be controlled.

There are consequently two distinct problems connected with ginneries: (*a*) the influence of seed dumps on stainer population as compared with that of wild food plants; (*b*) the effect of seed dumps on percentage of stainers infected with *Nematospora*. This second effect could be determined directly by bagging stainers from seed dumps and from wild host plants. The combined effects of (*a*) and (*b*) can be ascertained in the field only by a very large number of observations on clean and infested ginneries, because the ginnery problem is masked by the effects of climate and bacteria. The effect of climate can be reduced by selecting some plots near ginneries and others further away from the same ginneries; these plots should otherwise be of similar type.

Observations on plots close to ginneries and at a distance of three miles from ginneries conducted at the same time as above in Teso and Buganda gave the following results:—

Clean ginneries (near to) ...	12·45	Infested ginneries (near to) ...	16·4
„ „ (far from) ...	10·00	„ „ (far from) ...	12·6

In both cases the differences were significant, P. being less than 0·01. The indications are that the clean ginneries may not all have been as clean as they appeared, but there does appear to be more stain on the whole near to ginneries than far from them. The experiment affords no indication as to the cause of stain in cotton plots more remote from ginneries.

Series of observations extending over the season were made to determine the stainer populations on various alternative food-plants and on heaps of cotton seed. The results have not yet been fully examined but they indicate that, in Teso at least, a complete burning of the grass reduces the range of wild malvaceous food to certain weeds (*Abutilon* and *Wissadula*) growing in cultivated or recently cultivated plots. The *Dysdercus* on these would be controllable but for a most unexpected alternative food plant—*Sorghum sudanense*. There are, however, indications that stainers will breed in plots of Sudan grass only when the ripe seed-heads are closed and in a rather moist condition. This point requires careful investigation.

Records were made of stainer populations on cotton plots to determine possible migration; the figures obtained can be correlated with those for wild food-plants and also for climate. This question should receive further attention. The rate of rise of stainer population on cotton indicates the value which hand-collection would have; there was no indication of migration to the cotton, the increase appearing to be due entirely to breeding on the plots, but the figures will require further consideration before the exact position can be defined.

Further studies were made of the effect of Lygus on cotton, more particularly in the Eastern Province. One great difficulty in any investigation of Lygus is the lack of knowledge as to how many species or forms are involved: the forms show considerable variation, and separation of the true species will be possible only after detailed systematic study including (probably) examination of male genetalia. The collection and rearing of Capsid bugs, allied to the cotton Lygus, on crops and on wild plants were continued, and a large collection was accumulated. A thorough study of this material is an urgent necessity to determine whether more than one species is involved in the damage to cotton and what is their importance in connection with crops grown near, or in rotation with cotton. The observations which follow must therefore be assumed to apply to all species of Lygus found on cotton, which resemble *L. vosseleri*. There is as yet no evidence that the other species clearly distinct from *vosseleri* are serious pests of cotton.

In addition to *Vigna catjang*, *Phaseolus* sp., *Cajanus indicus* and other Leguminosae, this insect was found on the millets *Eleusine coracana* and *Sorghum vulgare*. Those from *Eleusine* fed readily on cotton at Serere, producing typical damage on young leaves; the control plants were quite normal.

Exclusive series of counts were made on the plants of the large Sowing Date—Spacing —Variety trial at Serere with the following results:—

Percentage of Plants Attacked (July 14th).—There are no significant differences between April and May Sowing Dates, Varieties or Seed Treatments.

The interaction Variety × Sowing Date is significant in that S.G. 29, S.P. 1 and S.P. 20 showed heavier infestation in the April plots than in the May plots.

Degree of Attack.—As a refinement of the crude numbers of plants attacked in each plot, a detailed examination of the degree of attack as measured by the extent of leaf-damage was made on a sample of four rows of plants in each plot. The damage was estimated for each plant on a scale of 1 to 10 and the results, expressed as average degree of attack per plant, are as follows:—

Var. S.G. 29 ... 1·55	Var. S.P. 1 ... 1·36	Var. S.P. 21 ... 1·27
„ S.P. 72 ... 1·39	„ S.P. 20 ... 1·32	„ S.P. 48 ... 1·19

Least Significant Difference: 0·166.

The interaction—Variety × Sowing Date—is significant in that S.G. 29 was more highly infested in the April sowings and less in the May sowings, the difference being significantly in excess of that of the other varieties in the two sowings.

The position of the plots had a significant effect on leaf-damage due to Lygus; possibly this may be due to soil differences.

A count of the total buds+flowers+bolls was made on a sample of each of the April plots af S.G. 29, S.P. 72 and S.P. 48 with the following results:—

S.G. 29 (Nyasaland var.)	... ...	per plant 14·54
S.P. 72 (Nariama derivative of Nyasaland)	... ...	„ 15·92
S.P. 48 (U. 4 derivative)	... ...	„ 20·48
Least Significant Difference	... ...	„ 1·89

Covariance Lygus Attack and Total Buds, etc.—Analysis of this variate gives a residual negative correlation between the degree of Lygus attack and Total Buds on the plants (value=0·0773). This is to be expected since Lygus is known to feed on the young tissues of the bolls and would therefore tend to reduce the numbers of bolls remaining on the plant as counted, and by sucking the growing points it reduces the formation of buds and branches.

Correcting the variety means of the total buds, flower and bolls for the effect of Lygus attack, the following values are obtained:—

Varieties.—			
S.G. 29	15·14	... ...	100%
S.P. 72	16·53	... ...	109%
S.P. 48	20·92	... ...	138%
Least Significant Differences	2·4	... ...	16%

These figures may be taken as an indication of the bud production of the plants as determined by varietal characteristics of habit, etc., at Serere. These calculations were made by the Mycologist. The degree of resistance of the U. 4 strains is in part due to their freer branching and fruiting habit though not entirely so.

The plots were again counted on August 10th and it should be pointed out that the Jassid counts done at the same time and given after the Lygus damage counts, place the varieties in approximately the same order. The Nariama and S.G. 29 being far more susceptible than the U. 4 cottons (as pointed out above) the damage is far more likely to be due to Lygus (or to bacterial disease) than to Jassid.

Lygus Damage on 10th August.—The figures below show average damage to the plants on a scale 1—10:—

Sowing Dates: April, 1·66; May, 2·12; June, 2·25.
Least Significant Difference, 0·32.

Varieties: S.G. 29, 2·37; S.P. 72, 2·11; S.P. 48, 1·93; S.P. 21, 1·93; S.P. 20, 1·92; S.P. 1, 1·91. Least Significant Difference, 0·12.

Jassid Nymph Count on 28th August.—The figures give the average per plant, 10 leaves each of 10 plants in each plot being counted.

Sowing Dates.—No significant differences were shown.

Varieties.—S.P. 72, 7·36; S.G. 29, 4·52; S.P. 48, 4·18; S.P. 1, 4·15; S.P. 20, 4·03; S.P. 21, 3·85. Least Significant Difference, 0·62.

Lygus damage on the variety trial was again counted in September; the variety and sowing date totals (which should be divided by 12 to obtain the variety mean) were as follows:—

	May.	June.	July.	G.V.T. (÷ 36 for mean).
S.G. 29	31·82	31·97	25·61	89·4
S.P. 1	25·32	29·17	24·21	78·7
S.P. 20	24·47	26·92	23·61	75·0
S.P. 21	24·87	25·96	23·60	74·43
S.P. 48	25·40	25·70	23·37	75·53
S.P. 72	33·50	30·67	28·53	92·70
S.D. total (÷ by 72 for means)	165·44	170·39	148·93	L.S.D. 3·53 (for varieties).

Conclusions.—S.P. 72=S.G. 29>>S.P. 1 and U. 4 varieties.
S.P. 1>S.P. 20=S.P. 21=S.P. 48.

Varieties × Sowing Date.—S.G. 29 was low for July sowings. There are no significant differences between the sowing dates.

The number of bolls and buds formed were counted on a sample of one row in each plot. There was no correlation between Lygus damage at that date, and bud and boll production counted at the same time; does not imply that there would be no correlation between *earlier* damage and crop present. It is also clear, when examining the plots, that some of them (particularly the earlier sowings) were producing more top crop and thereby compensating in some degree for loss of main crop. It is, of course, obvious that the top crop was likely to suffer more from stainer damage (and from Pink Bollworm damage when this insect spreads to Serere). The earlier sowings in general had, however, a better crop.

The variety totals were as follows and should be divided by 12 to give the variety mean of bolls, buds and flowers per plant.

	May.	June.	July.	G.V.T.
S.G. 29	128·2	89·0	45·7	262·9
S.P. 1	201·5	148·9	57·8	408·2
S.P. 20	208·7	152·3	62·4	423·4
S.P. 21	244·9	169·5	55·5	469·9
S.P. 48	229·3	161·7	71·0	482·0
S.P. 72	116·5	78·5	36·8	231·8
	1,129·1	819·9	329·2	...

The April sowings were not counted because harvesting had begun. The counts of these on July 23rd were: S.G. 29, 28·82; S.P. 48, 63·55; S.P. 72, 33·92.

An extensive tour with the Mycologist was undertaken in September and included the whole of the Lango and Eastern Province variety-trials and the "Soil-Climate-Insect" plots. On the latter, observations were made on Lygus damage and Jassid population and these are included in Table I. The damage due to Lygus was estimated on a scale of 1—10 on each plant in the four centre rows and the mean is given for each plot. (Presence without damage was estimated as "1", such a figure as "5" represents about 50% damage to the plant at the time of examination). The results of these examinations on the variety trials are given in Table II and the conclusions indicate that in the environments examined, the U. 4 cottons are definitely less palatable than the other varieties, though (as mentioned above) their larger crop is mainly due to their habit of growth, which gives them an equally great or even greater advantage by enabling more bolls to be formed despite Lygus damage.

The effect of environment on the amount of damage is very considerable. It will be seen that at Vukula the figure for S.G. 29 in one trial was only a little more than half that in the contiguous trial planted at the same time. The differences between the other plots are in some cases accounted for by the age of the plants or other factors which make comparison impossible. Plants which are very seriously retarted in growth and likely to give only a very poor crop are rarely severely damaged by Lygus. For this reason an obviously false correlation between Lygus damage and crop (*i.e.*, more Lygus damage, more crop!) is obtained in some instances. When finally interpreting the figures great care will be necessary because in intermediate cases rather poor growth may result in little Lygus damage and rather better growth in more Lygus.

TABLE I.—CLIMATE—SOIL INSECT PLOTS. EXAMINED SEPTEMBER. 1934.

Place.	*LYGUS.*				*JASSID.*			
	S.G. 23/8	S.G. 29 (18).	S.P. 13 (19).	Total.	S.G. 23/8	S.G. 29.	S.P. 13.	Total.
Serere	(1·49)	(1·16)	1·14 †Ishan 1·09	3·79				
Katakwi	3·03	2·09	3·11	8·23	1·7	1·7	2·6	6·0
Ngetta	6·49	6·52	3·93	16·92	1·3	1·8	1·2	4·3
Kaberamaido	4·60	3·47	2·75	10·82	1·2	1·6	1·6	4·4
Simsa	3·00	2·22	1·86	7·08	—	—	—	...
Nyero	5·42	5·55	4·32	15·29	2·4	2·5	2·0	6·9
Mbale	7·51	6·29	5·63	19·43	2·0	1·5	2·4	5·9
Mulanda	5·74	6·37	5·67	17·78	2·2	2·0	2·0	6·4
Vukula	4·95	5·19	5·83 Local 4·11	13·97	2·0	2·0	1·4 Local 1·7	5·4
Bugaya	0·48	0·89	0·09*	1·46	1·9	2·0	1·7	5·6
Bulopa	0·30	0·57	0·53*	1·40	1·6	1·6	1·5	4·7
Wanyange	1·61	2·08	1·15	4·84	2·9	2·2	2·3	7·4
Aduku	4·74	4·92	3·72 Local 3·78	13·38	1·9	1·9	2·1	6·9
Kibale	6·81	5·87	5·23	17·91	2·0	1·6	2·8	6·4
	54·68	52·03	41·82	148·53	23·1	22·4	24·6	
L.S.D. Variety Totals ...			5·99					
Nakasongola	0·41	0·82	0·33 B. Local 0·78	2·04				
Kiboga	0·30	0·32	0·0 0·13	0·75				

† Not included in statistical analysis. * Small plants.

A further environmental effect was noted in the sowing date trials, the early and late cotton appearing to be the least severely affected.

It is clear that climate, soil and variety are important in influencing damage to the leaves and shoots of cotton by Lygus. The fact that there are indications of the later cotton being less severely attacked suggests that the environmental effects are more important than those due to initial Lygus population, the control of which, if the two main grain crops are the chief alternative hosts, may prove extremely difficult.

TABLE II.—VARIETY TRIAL PLOTS EXAMINED SEPTEMBER, 1934.

Variety Means.

Centre.	S.P. 1	S.P. 22	N. 17	S.G. 29	L.S.D.	Conclusions.
Mbale	4·84	4·91	6·06	6·01	0·44	
Aduku	3·50	3·37	3·99	4·09	0·43	S.G. 29 = N. 17 > S.P. 1 = S.P. 20.
Kaberamaido ...	3·79	3·85	4·73	5·27	0·70	S.G. 29 = N. 17 > S.P. 1 = S.P. 20.
Ngetta	5·72	5·83	6·82	6·46	0·52	N. 17 = S.G. 29 > S.P. 20 = S.P. 1.
Nyero	4·99	4·74	6·79	6·42	0·61	
Mulanda	3·80	4·37	5·97	5·56	0·72	
Vukula	1·62	2·02	2·13	2·37	0·51	
Kibale	5·03	5·18	6·05	5·86	0·45	S.P. 1 = S.P. 20 < S.G. 29 = N. 17.

The above combined, using *Variety Totals* (*not Means*).

Var. *Totals*	133·62	137·14	171·16	168·25	5·40	Squares, rows, columns, varieties, var. × columns all significant. U. 4 less palatable than Nyasaland.

Plots not included in combined analysis (variety *Means*).

Bulopa	0·81	1·06	0·86	0·79	...	Not significant.
Bugaya	1·59	1·81	1·77	2·23	...	
Wanyange	1·02	1·41	1·70	1·39	...	

VARIETIES.

	B. Local	B. 31	S.G. 23·8	S.G. 29	L.S.D.	
Wanyange	2·93	2·42	2·40	2·29	...	Not significant.
Bugaya	2·45	2·63	3·38	1·82	...	
Vukula	4·60	4·55	4·52	4·07	...	

SOWING DATES.

	April.	May.	June.	July.	L.S.D.	Sowing Date Means.
Katakwi	0·69	1·49	1·35	1·31	0·69	April < May = June = July (might get worse or better, still very young.
Ngetta	1·6	2·43	3·46	0·83*	0·46	April < June July still young but < others.
Wanyange	...	1·08	dead	0·43	...	(August cotton too young to count).
Mbale	Some plots missing; results not worked out.					

* Calculated from a different trial.

The following notes were made at the variety trial centres and are relevant to Table II.

Mbale.—The sowing date experiment requires special statistical analysis and the results are, therefore, not yet worked out.

Aduku.—S.P. 20 appears to be a more uniform variety than the others and the variation between the amount of Lygus damage on the individual plants was less than on the other varieties, being about 3—4 (factorial count). The branching of this variety (enabling it to grow away from Lygus) appeared somewhat better than in other U. 4 varieties. Lygus was not yet passing off.

Kaberamaido.—(Plot 15 not comparable). At this close-spacing and at this centre, where plants tend to become woody, the habit of the U. 4 varieties to branch, despite Lygus, is marked.

Ngetta : Sowing Date Experiment.—The early cotton showed little damage though its advanced stage of growth made estimation difficult; in the absence of disease this cotton would have produced a good crop. Though the latest plots were young the lack of damage appeared to be real when potential crop was considered. The U. 4 varieties showed the advantage of habit and might well produce a crop double that of the other varieties.

Nyero.—The estimation of Lygus damage was rendered difficult owing to the loss of branches due to Blackarm disease. Either of these two factors appeared capable of reducing the main crop (as opposed to the top crop) by 50% on the worst varieties. These plots appeared to be fairly typical of the native plots in the area, which did not show much improvement until Bukedea was reached.

Mulanda appeared a fair sample of the district but July plots showed less Lygus damage. Some plots showed a bunched "witches-broom" growth somewhat resembling damage by *Helopeltis;* this was tentatively ascribed to severe and early Lygus attack.

Vukula.—Poor germination in some of the plots had resulted in uneven age of plants. In some plots the varieties did not appear as even as in other trials. Plots furthest from the road had smaller plants (clearly a soil effect) and this accounted for lower Lygus counts due to an obvious soil difference. Native-planted June cotton near the trial was wider-spaced and showed more branches and bolls and less Lygus than the variety trial.

Kibale.—The plots were disappointing; there seemed more Lygus damage on them than on native plots. Both earlier and later planted native cotton were definitely better.

Bulopa.—Plants of all plots were very small (retarded growth). The trial of Buganda varieties was too poor to estimate Lygus.

Bugaya.—Some of the plots were on very poor soil and the plants very small, consequently the Lygus counts were very low and their significance doubtful.

Wanyange.—Some plots in the variety trial were very uneven indeed, but counts gave a moderately true picture; the plot containing the Buganda varieties was more even and the "Soil-Climate-Insect" plots were quite even. The Lygus damage on the early cotton in the sowing date experiment was very small. The system of recording necessitates "1" being given if damage exists, but on old cotton-plants showing only this amount of damage no reduction of crop is suggested.

Katakwi.—Earlier examinations showed no appreciable Lygus in Usuku; later there was some increase.

Simsa.—Plants were very small, showing drought and, possibly, poor soil.

Busoga in General.—The Busoga trials did not give any idea of what was happening in the district. The early cotton did not seem to be severely attacked by Lygus and the late cotton appeared to be avoiding it also; there was very little cotton of an intermediate age.

The N. 17 selections at Ngetta, designed to obtain Lygus-resistant varieties, were examined for Lygus damage. The following means were obtained:—

Row Nos.: 39, 2·8; 31, 3·17; 32, 2·62; 33, 2·44; 34, 2·46; 35, 3·16; 36, 2·77; 37, 2·18; 38, 1·48.

Mean: 2·564.

Controls: Mean, 3·887.

Difference due to selection: 1·323; $P = <0·01$.

It appears, therefore, possible to select for resistance to Lygus within the variety N. 17. The differences were not very striking when looking at the rows but the selections were definitely better in appearance.

During the same tour counts were made on the "Soil-Climate-Insect" plots. The varietal differences were again clearly shown. There were also large differences between centres and also differences between plots. These results were handed over to the Agricultural Chemist for consideration in connection with his work on the soils.

The climate records have not yet been studied nor have the final yields yet been received for correlation with the insect attack. The figures obtained for Lygus damage are appended. (The counts of Jassids were very low and not significant).

The "Soil-Climate-Insect" plots were later examined for potential yields and the total production of buds, bolls and insect damage to these were estimated. These figures will require much further careful statistical examination and must be correlated with soil, climate, Lygus and disease attack before conclusions can be drawn. The differences between varieties have been analysed by the Mycologist and are summarised below.

Analysis.

Total Flowers.

Total	...	50	...	9,814	...	3,664·98		
Centres	...	16	...	24,594	...	2,048·98	...	128·06
Varieties	...	2	...	106,150	...	95·10	...	47·55
Error	...	32	...		...	1,520·90	...	47·52

No difference between varieties. L.S.D of Centres = 34 flowers. $P<0·5$.

Buds.

Total	...	50	...	934,460	...	321,313·65			
Centres	...	16	...	2,530,996	...	230,518·98	...	14,407·44	$P<0·01$
Varieties	...	2	...	10,497,730	...	367·18	...	183·59	
Error	...	32	...		...	90,427·49	...	2,825·86	

No difference between varieties. L.S.D. of Centres = 266 buds.

Small Bolls.

Total	...	50	...	109,435	...	45,481·35			
Centres	...	16	...	267,666	...	25,268·35	...	1,579·27	$P<0·01$
Varieties	...	2	...	1,175,810	...	5,211·65	...	2,605·83	$P<0·01$
Error	...	32	...		...	15,001·35	...	468·79	

L.S.D. Variety Totals=258 bolls. L.S.D. Centres Totals=108 bolls.

Medium Bolls.

Total	...	50	...	90,454	...	36,096·65			
Centres	..	16	...	217,313	...	18,080·31	...	1,130·02	$P<0·01$
Varieties	...	2	...	1,100,693	...	10,389·29	...	5,194·65	$P<0·01$
Error	...	32	...		...	7.627·05	...	238·35	

L.S.D. Variety Totals=184. L.S.D. Centres Totals=77.

Large Bolls.

Total	...	50	...	178,260	...	49,356·16			
Centres	...	16	...	467,854	...	27,047·49	...	1,690·47	$P<0·01$
Varieties	...	2	...	2,404,490	...	12,536·74	...	6,268·37	$P<0·01$
Error	...	32	...		...	9,771·93	...	305·39	

L.S.D. Variety Totals=208. L.S.D. Centres Totals=87.

The work on the "Soil-Climate-Insect" plots is not yet completed even for the past season as many of the climatic figures were not received until recently and much statistical treatment is yet needed.

The following hypotheses are put forward for future consideration :—

Lygus damage results when the plants are succulent. In areas which have been deforested and which have marked dry seasons, cotton must be sown early so that it makes most of its vegetative growth during the early rains and further growth during the late rains. In drier districts therefore the young cotton actually gets more rain and is temporarily more succulent, it therefore suffers more from Lygus during the growing period.

In very dry districts which also have a high phosphate content in the soil the succulent condition cannot develop and Lygus damage is absent.

In areas with a more even climate, cotton can be sown later during the period between the early and late rains. In these areas the young plants get less rain than in the dry areas and suffer proportionately less from Lygus.

The intermediate conditions appear to be more finely balanced and the subject is being investigated by the Agricultural Chemist.

As a result of the suggestion that Lygus damage at Serere was not due to this insect a repetition of the spraying experiment was done. Owing to the very wet weather and to delay in the commencement of spraying, the experiment was only partially successful. Tobacco dust, suggested by the Senior Agricultural Officer, Eastern Division, was also tried. The opportunity was taken to keep further records of seasonal prevalence and to endeavour to ascertain by statistical methods the extent of damage.

The *total* Lygus per plant on the samples examined, summarised to October 31st, were :—

	Adults.	*Nymphs.*	*Total.*
Control	3·61	3·88	7·49
Sprayed	2·75	3·08	5·83
Dusted	3·41	3·81	7·22
L.S.D.	0·73	0·45	0·93

The spray effected an appreciable reduction in the insect numbers but the effect of dusting was negligible.

The remaining data from this series of observations will be correlated with climate and with the figures obtained in previous years. The evidence on which Mr. Hancock based his conclusions regarding loss of crop and damage to cotton by Lygus bugs has been prepared at the request of the Director of the Imperial Institute of Entomology for publication in Vol. 26 of the *Bulletin of Entomological Research.*

Considering the question of "resistance" of cotton varieties to insect attack in connection with variety trials and the "S.-C.-I." plots, it would appear that U. 4 cottons (S.P. 1, S.P. 13, S.P. 20 and their relatives) have, in general, more "resistance" to Lygus, Jassid and Aleurodid bugs than have the Nyasaland or Nariama strains. The merits of cotton varieties are not considered here but it seems advisable to mention certain characteristics possessed by the "resistant" strains :—

They are very hardy and adaptable. The damage by insects is smaller and under the more humid conditions of some areas they do not develop a greater amount woody growth than do the more delicate varieties.

Their leaves are rather hairy and they appear to be less readily attacked by insects.

They are less palatable to Lygus, and possess a habit of branching and fruiting which enables more bolls to be matured when Lygus damage is intense.

They can be spaced more closely and should therefore give a full stand more easily in the presence of crickets and cut-worms.

When comparing varieties the possibility that the more "resistant" types may have a different optimum spacing should be tested.

Locusts.

The Tropical Migratory Locust (*Locusta*) persisted in small numbers in many parts of the Protectorate until September, when the infestation became restricted more or less to the central and western districts. Breeding on a small scale occurred and the resultant hopper bands were in most instances small and lacking in cohesion. At the end of the year few swarms remained. Some damage was caused locally to grain crops, the damage being more extensive in the northern districts than elsewhere.

Swarms of the Red Locust (*Nomadacris*) entered the Protectorate from the south during June. The northern limit of the invasion appears to have been 1° 15′ North Latitude. The heaviest infestation occurred in the southern and south-western districts, particularly Kigezi where, as well as in Ankole, considerable damage to crops was reported to have been caused. Some egg-laying took place in Ankole during November, but a large proportion of the eggs either rotted or shrivelled and hatchings were on a very small scale.

Reports on the locust situation, and maps shewing distribution, were compiled monthly for the information of adjacent territories and of the Imperial Institute of Entomology.

Miscellaneous.

Advice was sought and given on the following :—

May-fly larvæ in the submerged parts of piles: a fungal rot (*Polyporus*) had attacked the alternating softer layers of the pitch pine; the larvæ appeared to have scraped away the rotten wood and were living in the cavities thus formed.

Tapesia grisea, Sj., grasshopper, attacking *Amaryllis* leaves; locust bait was tried but proved ineffective.

Gryllus gracilipes, Sauss., cricket, attacking carnation and chrysanthemum during very dry weather only; locust bait proved partially effective.

Termites attacking rose bushes; in both instances the plants were recent importations which had not established root-systems (nearby plants with well-developed roots were not attacked).

Millipedes attacking carnation roots.

Alcides dentipes. Fab,, weevil, in stems of young sweet-potato plants during dry weather; this pest usually infests only old woody stems at the end of the season.

Megalognatha. sp., beetles eating young leaves of mango.

Bostrychid beetles in joists of a newly-erected buildings: freshly-cut (unseasoned) timber had been utilised and the insects were mainly in the sap-wood.

Sphenoptera. sp., beetle larvæ in roots of *Tephrosia vogelli.*

Apate sp., beetle, boring in native-grown coffee stems.

Cochchafer beetles (2 spp.) eating rose flowers and leaves.

Orthezia insignis, Dougl., scale on *Lantana.*

Icerya sulfurea, Lind., and *Stictococcus formicarius,* Newst., scales on *Tectona grandis* (teak).

Fly-maggots attacking undeveloped flower spikes of gladiolus.

The borer in orange trees mentioned in para. 19 of the report for 1933 has been indentified as *Monochamus ruspator,* Fab.; later observations have shown that the bark disease was the predisposing factor to attack by the beetle.

In compliance with instructions received, arrangements were made for the importation from Java of the beetle *Plæsius javanus,* a predator of the banana weevil *Cosmopolites.* A consignment of 600 beetles despatched on September 5th reached the laboratory on October 19th and 225 were found alive. To prevent any possibility of the introduction of diseases of banana the beetles were kept in quarantine. Observations on the conditions of banana culture and on the intensity of *Cosmopolites* infestation were made on Kibibi Isle, Lake Victoria, in January, 1935, and the surviving beetles were then released there. Since the reproduction of *Plæsius* is rather slow, a considerable period must elapse before there is an increase in numbers sufficient to determine its survival. A second consignment of 820 beetles from Java all died prior to arrival.

Two series of detailed observations were made on the coffee trees to test the effects of different methods of planting on the prevalence of sucking insects and on the general health of the trees.

In the absence of an artifical drier, the possibility of killing *Stephanoderes hampei,* Ferr., in coffee berries, stripped from trees in consequence of intense infestation, by immersion in cold water was investigated. It was found that even after several days' immersion, by which time a mass of fungus had developed, the only beetles killed were those which had but recently entered the berries.

The efforts for development of beekeeping among natives for wax production have been continued. Tours for instruction and demonstration were undertaken by the Laboratory Assistant in Kigezi, Ankole and Masaka Districts.

Instructions regarding the preparation of wax have been written for the guidance of beekeepers and will be printed in two vernaculars and published as a leaflet. An article on beekeeping was written for inclusion in the proposed new Uganda Handbook.

A course of instruction was given to students of agriculure from Makerere College, and a native, supplied by the Kigezi Administration, was trained as Beekeeping Instructor for that district.

The construction and tests of additional types of hives for native use have been continued. A number of European frame hives have also been placed for testing. The one remaining hive with an imported Italian queen died out before a hybrid race was produced; the Conopid parasite fly, *Physocephala pubescens,* Brun., was responsible for the death of this colony.

Twelve instances of honey bees occurring as nuisances in buildings were dealt with.

Attempts to utilise the stingless bee, *Trigona denoiti,* Vach., as a means of pollinating clones of coffee selections, failed.

Tests were made of various possible repellants to prevent a small stingless bee, *Trigona braunsi,* Kobl., nesting in, and blocking up the mechanism of door locks. All proved useless, A coating of vaseline on the internal parts was found to be a lasting preventive.

The Government Entomologist attended the conference for Co-ordination of Agricultural Research and Plant Protection at Amani in February, and the International Conference on Locusts in London during September.

A comprehensive report on the subject of Pink Bollworm in Uganda written by the Assistant Entomologist, was submitted by the Government Entomologist to a meeting of the Central Plant Pests Board convened specially to discuss this subject.

The following articles and papers were written:—

"Climatic and Soil Factors in Relation to Prevalence of, and Damage by Insects" by H. Hargreaves, (Rept. 2nd Conf. Cotton Growing Problems, 1934).

"Some Notes on *Lygus vosseleri*, Popp." by G. L. R. Hancock (for publication in *Bull. Entomogical Research*).

"The Major Pests of the Cotton Plant in Uganda" by G. L. R. Hancock (to be published in the *Uganda Journal*, 1935).

"Bees Nesting in Key-Holes," by T. W. Chorley (*Uganda Journal*, Vol. II, 1935).

"Beeswax Production" by T. W. Chorley.

During the year, 219 packages of imported plants were examined.

Mr. H. K. Munro of the Department of Agriculture, South Africa, kindly undertook the identification of fruit flies (*Trypetidæ*),

The Imperial Institute of Entomology rendered valuable assistance in various ways, including the identification of insects and the preparation of coloured illustrations.

H. HARGREAVES,

Government Entomologist.

ANNUAL REPORT OF MYCOLOGIST, 1934.

The Mycologist was stationed at Serere during the whole year. From time to time, as was found necessary, short visits were made to inspect the district experimental plots in Usuku, and native plots in the vicinity. Two major tours of inspection were made of the District Variety Trials east of the Nile, and one of the similar trials of the Western Division. In December, a short tour was made through Masaka and Bunyoro districts, the former to inspect native plots in connection with Wilt disease of cotton, and the latter to inspect the newly issued S.G. 29 variety of cotton in that area. The Plant Pests Board meeting in Kampala in May was attended, and the Annual Conference of the Uganda Planters' Association in July.

PLANT DISEASES IN UGANDA IN 1934.

I. Diseases of "Bulo" (*Eleusine coracana*).

A. Blast Disease (*Piricularia* sp.).

In continuation of last season's work, in collaboration with the Assistant Botanist, Serere, observations were made on the behaviour of the latter's selections in the Breeding Plot, in respect to this and other diseases. Resistance was taken into consideration in making further selections for 1935.

On the whole, Blast was rather less serious during 1934 than during the previous season, both on the Serere plots and in native cultivations in the neighbourhood. Infection of the leaves and stalks was much less common, though late in the season a considerable proportion of heads became partially or completely infected.

Isolations of the causal fungus were made, and compared with a series of isolations of a similar fungus from *Digitaria* sp., the commonest weed in bulo fields. In culture these two fungi were indistinguishable. A series of inoculations on bulo were carried out with both series of cultures, on stems, leaves and young heads, without wounding the tissues. Very few positive results were obtained; it is evident that special conditions of temperature and humidity are required for successful infection.

During the year it was determined that the Blast fungus is present on ordinary native seed supplies; it occurs both on the surface of the seed and also inside the tissues. In the case of seed contaminated on the surface, infection of the cotyledon and roots takes place very rapidly when the seed is germinated under moist conditions, as on blotting paper in Petri dishes. The young seedlings are often killed completely under these conditions. Under similar conditions many seed showing internal infection will not germinate at all; the few that manage to germinate rarely survive more than a few days.

B. Helminthosporium Diseases of Bulo.

Two very distinct strains of *Helminthosporium* were isolated during the year from this crop. These have been provisionally identified as *H. leucostylum* Drechsler, and *H. nodulosum* Berk. & Curt. The former causes numerous elongated spots of deep brown to almost black colour on the leaves of the host. These spots may be up to 10 mm. long by about 1½ to 2 mm. broad, and may coalesce to form larger patches. Affected plants often show a withering of the older leaves, commencing by the distal portion turning reddish brown in colour; a similar discoloration is also common on plants affected by the Blast fungus, *Piricularia*.

Infection by *H. leucostylum* on the seedlings often causes a "blight": the young plants may wither off and die as a result of severe attack. On the heads infection may result in the death of one or more of the "fingers" of grain, such infected parts remaining in a withered state in the mature heads. Attack at a later stage in the development of the grain results in a varying amount of partially filled grain. Affected ears usually show a dark grey to almost black growth of short conidiophores bearing conidia; this growth is darker in colour than that of *Piricularia*, which is almost white. As a rule, *Piricularia* is found to be the most common fungus affecting the ears of the crop.

The spores of the fungus are carried on the seed, but hitherto at Serere no cases have been found of internal infection of the seed by this fungus. *H. leucostylum* occurs in the field as a common mould on dead and dying leaf and culm tissues of *Eleusine*, especially when the crop is left standing in the field for some time after harvest. So far this fungus has been found only on *Eleusine coracana* at Serere; the common grass *E. indica* does not show natural infection in the field, even when growing amongst infected bulo.

Helminthosporium nodulosum has been found at Serere to cause a stem blight and foot rot of bulo. Infected plants show a dark rot of the base of the plant and dark areas on the culms. The culm symptoms are very similar to those caused by *Piricularia*, but the infected areas are usually darker in colour than those caused by the latter fungus. Spots are also caused by infection on the leaves, and are linear, about 10 by 1 mm., with a dark

layer of conidiophores and conidia present in moist weather on the older spots. Plants dead or dying as a result of stem infection are covered over considerable areas with a similar fruiting layer.

When infection takes place near the base of the plant, at a comparatively early stage in the season, growth is retarded, and the plants often dry out completely before harvest, producing little or no crop. The leaf form of the disease appears to do little damage, as far as records are available, but the stem form is comparatively serious and causes much damage on susceptible strains. On the whole the stem disease caused by *H. nodulosum* ranks next to that due to *Piricularia* in importance. *H. nodulosum* is also capable of causing a blight of the ears, similar to that due to *H. leucostylum*, but this type of infection is much less common in the field, where the most important ear diseases are due to *Piricularia* and *H. leucostylum*.

C. "Sterility" of Bulo.

During 1933 a large number of selections were made by the Assistant Botanist, Serere, from about a dozen native strains of the crop. Individual plants were selected for yield, strength of straw, large heads, uniform ripening and resistance to Blast and other diseases. The seed of these single plant selections was sown in lines during 1934. Later in the season it became evident that on two large patches of the plot the plants were abnormal. Growth was retarded, as compared with that in other parts of the plot, and the plants in some cases showed a tendency to excessive tillering, though this was by no means universal. After flowering the heads of these plants appeared quite abnormal, much resembling those of *Eleusine indica*. When ripe, instead of containing normal grain, these heads were either sterile or contained a few very small dark seeds.

The occurrence of the "disease" patches in the plot was not altogether correlated with the position of the progeny rows; many rows showed a few normal plants towards one end, with the rest completely abnormal. The distribution of affected plants appeared to indicate either a place effect due to soil differences or alternatively the spread of some obscure disease from plant to plant. No fungi or bacteria were found on affected plants which did not also occur to much the same extent on normal plants. After some correspondence with the East African Research Station, Amani, seed of varieties showing different degrees of "infection" were forwarded there for study. As no precautions had been taken in 1933 to self fertilise the parents of the 1934 progeny rows, it was thought possible that the abnormality might be due to out-crossing with *Eleusine indica*, which is a common weed at Serere. The Amani Station reported that no evidence of out-crossing could be obtained from the results of growing the seed at Amani, nor any evidence of a hereditary factor for sterility. The sterility observed at Serere does not agree with the descriptions of sterility in *E. coracana* in India as given by Ayyangar and Krishnaswamy (*Indian Journ. Agric. Sci. I*, pp. 554-562, 1931).

As against the view that the condition is due to patches of poor soil, experience at Serere on other parts of the farm indicate that poor soil conditions lead to stunting of the plants and favour infection by various fungi, notably *Piricularia*, *Helminthosporium* and *Gibberella Saubinettii*. If the conditions are very severe flowering may be completely prevented. In 1933 plants of this crop growing on poor patches of soil, and near ant-hills, gave very little yield, but no evidence of the *E. indica* or "sterile" type of head; their heads were normal in everything except size, and the grain of normal appearance.

D. Foot Rot (*Gibberella Saubinettii*).

This disease was seen again in 1934 at Serere and in native plots; it is often limited to plants growing on poor patches of land near ant-hills.

II. Diseases of Groundnuts (*Arachis hypogaea*).

A. Rosette Disease.

Observations on this disease were limited to the Breeding Plot at Serere, where detailed records were kept of incidence week by week. Definite differences were found in this plot in the incidence of the disease on the various varieties and selections; a few strains showed very little infection at harvest.

An attempt was made to differentiate between the types of rosette infection found in this plot, as shown by differences in the symptoms of infected plants, and to correlate these types with the effect on yield. Other diseases were included in this analysis, which gave the following results:—

Disease.	Bunch Type.	Spreading Type.
Cercospora Personata ...	113·0	100·1
Rosette	94·0	57·6
Mottling of leaves ...	115·2	94·0
"Yellow Rosette" ...	70·7	74·2
Rosette+Mottling ...	67·6	43·6
Rosette+Yellows ...	77·0	46·4

Note:—The yields in the above table are expressed as a percentage of those of corresponding healthy plants.

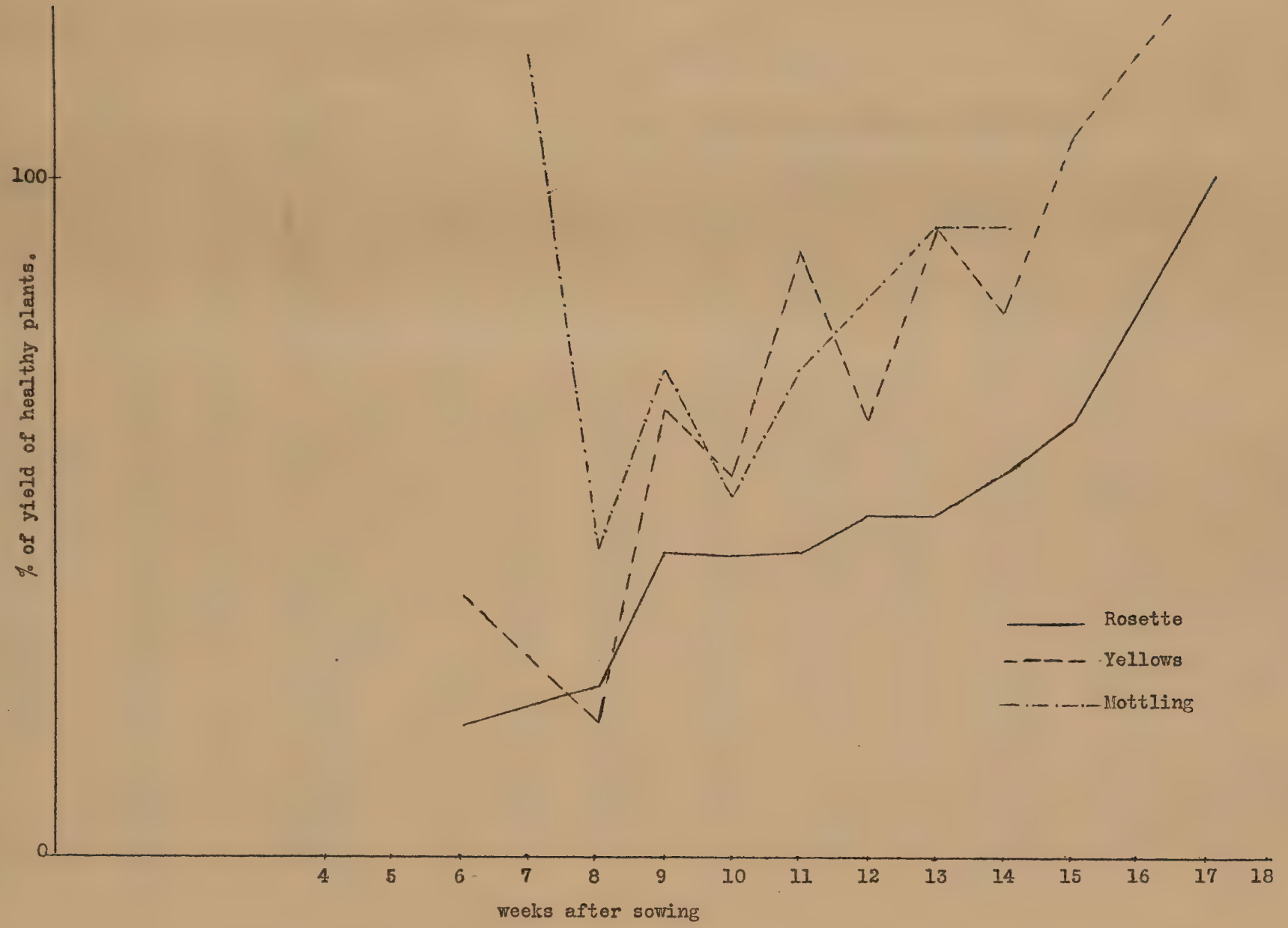


Fig. I. Effect of date of Infection on Yield of Spreading Groundnuts.

In the foregoing table the following differences are significant:—

Spreading Groundnuts ...	Healthy and Rosette	...	($P<\cdot01$).
	Healthy and Yellows	...	($P<\cdot01$).
	Rosette and Yellows	...	($P<\cdot05$).
	Mottling and Rosette	...	($P<\cdot01$).
	Rosette and (Rosette+Yellows)		($P<\cdot05$).
Bunch Grouudnuts ...	Healthy and (Rosette+Mottling)		($P<\cdot01$).

We have obtained no indication that infection by *Cercospara personata* has any effect on yield of either type of groundnuts, at least on the varieties and selections grown during 1934 at Serere.

The three types of "Rosette" included in the above table are characterised as follows:—

"*Rosette.*"—Infected plants showed typical stunting and condensation of the stems and branches, but the leaves remained more or less uniformly green in colour.

"*Mottling.*"—The plants showed a mottling of the leaves with two shades of green colour; no typical rosette symptoms were present, nor any pronounced yellowing of the lighter green areas of the leaves.

"*Yellows.*"—The leaves of affected plants showed a very pronounced mosaic effect; the lighter areas varied from bright yellow to almost white, and occupied a varying amount of the leaf area. On some plants there was very little of the normal green colour left in the leaves. No rosette symptoms were shown by plants included in this category.

The other two divisions of the above table include plants showing combinations of these viruses; infection was not by any means simultaneous, in most cases the Rosette symptoms followed those of the other types on the same plant.

It is evident that the diseases distinguished as "Rosette" and "Yellows" above have most effect upon the yield of the crop, and there is some evidence that they are separate diseases, at least in so far as their effect upon yield is concerned. In the case of the Bunch type, in the plot under observation infection occurred so near to harvest time that the effect of the various diseases on yield was minimised.

The accompanying graph shows the effect of date of infection by the three types of virus disease on the yield of spreading groundnuts in the observation plot, the yields being expressed as a percentage of those of plants remaining healthy at the end of the season.

B. Wilt Diseases (*Sclerotium Rolfsii, Rhizoctonia bataticola* and *Fusarium oxisporum* var.).

During the year no evidence was obtained of seed transmission of these diseases, which in 1934 occurred on individual plants or on small groups of plants, scattered through the plots at Serere and in the district. The most common wilt organism found during the past year was *S. Rolfsii; Fusarium* wilt was rare.

On the Serere Breeding Plot, records were made of the position of infected plants, so that when the plots are again planted with this crop it will be possible to collect evidence of the survival of these diseases in the soil under normal conditions of crop rotation and cultivation.

The incidence of the disease in this plot was so small as to render it impossible to collect data on the relative susceptibility of the various strains and selections of the crop; we are forced to rely on the selection of strains showing no disease for future propagation.

C. "Tikka" Disease (*Cercospora personata*).

This disease is still of little or no economic importance in Uganda. As noted above, on the strains of the crop grown at Serere in 1934, no evidence could be obtained that this disease had any effect on the yield of the plants attacked. Any strains showing a tendency to abnormal leaf fall when attacked by this disease are automatically discarded so as to keep up the present level of tolerance to the disease.

Some strains, notably a selection from Philippine Pink, showed less infection by *C. personata* than most of the varieties grown in the Breeding Plot.

D. Leaf Spot (*Cercospora arachidis*).

This leaf spot was again observed on occasional plants at Serere and all over Teso district, but there is no evidence of its having any effect upon yield; at present it cannot be considered of any economic importance.

III. Cotton Diseases.

A. Blackarm and Angular Leaf Spot (*Bacterium malvacearum*).

On the whole, this disease was more in evidence during the past season than during the 1933-34 cotton season. Comparative counts made at Serere in November, 1934, on S.G. 29

indicated 50% more lesions per plant than in November, 1933. The following account is compiled from notes made during inspection tours of the areas mentioned :—

Teso District.—In the Usuku area, where the disease is often more serious than elsewhere in Uganda, Blackarm appeared in quantity towards the end of May and in early June, forming lesions on the main stems of the young plants. The July sowings in this area were heavily attacked in the same manner, and the general result was that cotton sown after mid-May received a serious check in its growth at a very early stage. The earlier sowings of April and May escaped serious infection at a similar stage in their growth, with the result that the plants grew more rapidly and evenly. Later in the season in the period August—December, a series of heavy infections took place during wet periods. During the intervening dry periods these infections partly dried out, but serious damage occurred, especially on plants already weakened by previous infection while still young. In December it was noticed that much of the young succulent growth formed during November was infected and frequenty dead.

In other parts of Teso, and in the parts of Lango and Bugwere districts adjoining, the history of the disease during 1934 was somewhat similar to the above, except that the infections were rather less serious. In most areas, however, the proportion of the crop sown before the end of June was rather below normal, the May sowings being particularly low. The result was that little of the crop as a whole escaped attack at an early stage in the development of the plants, when it is important that they should develop rapidly and unhindered. In the past season the effect of the disease was thus accentuated by the high proportion of late sowings. The season was generally one of alternating periods of dry and wet weather, and such conditions appear to have intensified the attack of the disease, possibly by lowering the resistance and growth rate of the plants.

Busoga District.—Very dry weather was experienced in June, so that June plantings were very small, and later plantings proportionately high. On the whole, in the southern part of the district, the incidence of Blackarm was less than in 1933, but in the northern parts the disease approached that found in Teso and Bugwere.

Buganda.—In the areas near Lake Victoria, between Jinja and Entebbe, the incidence of Blackarm was comparatively slight, and as far as could be seen, the disease had little or no effect on crop production. The incidence increased towards Masaka, where the earlier sowings showed serious infection. Farther from Lake Victoria, towards Lakes Albert and Kioga, the incidence and effects of the disease definitely increased. June sowings in Buruli showed many plants completely killed by the attack, which appears to have commenced in quantity in September and gradually reached a maximum intensity during November, in spite of the rather dry conditions. The rainfall measured at Nakasongola during this period was some 5 inches, but there was evidence of the occurrence of heavy local showers in many areas. During the months of September and October the plants appeared to have made considerable growth, which was largely killed off by the attack during November. The plants in December, at the time of my visit, showed the young branches killed and black, dried up with the leaves still attached. Infection on the bolls was high in all plots showing serious stem infection, and further reduced the crop. Many bolls with lesions on the walls had dried up and opened prematurely, with the contents completely useless for market. On the whole, the earlier sowings in Buruli yielded best and showed less severe Blackarm attack, possibly owing to their having been able to develop before the severe attacks took place.

Bunyoro.—Here the variety S.G. 29 was grown for the first time. In general the plants showed considerable infection by Blackarm and with evidence obtained from other districts and from experiments, we can only conclude that this variety is particularly susceptible to attack by Blackarm, as compared with other varieties which have been grown on any considerable scale in Uganda. In Bunyoro, S.G. 29 showed more infection than did "Buganda Local" cotton growing just over the border towards Kampala. At Bulindi, comparative counts of lesions per plant made on S.G. 29 and S.G. 23/8 showed the former to have roughly twice as much Blackarm per plant as the latter. At other centres counts made in December had shown no difference between infection on S.G. 23/8 and Buganda Local, so that we presume that had the latter been planted at Bulindi, it would have shown half the infection of S.G. 29. The growing season in Bunyoro was one of comparatively low rainfall, and in spite of this infection was definitely high.

In general, the 1934-35 cotton season was one of poor weather conditions, with alternating periods of wet and dry conditions. During the dry periods the plants suffered considerably from water shortage, possibly accentuated during such a season by poor root development owing to a tendency to waterlogging during the periods of heavy rain. Blackarm undoubtedly attacked the plants with greater effect than is usual, and was probably more serious than in some seasons in the past when the rainfall was actually more than in 1934-35, though more evenly distributed. It appears that any climatic factors which militate against a steady development of the plant throughout the season assist the disease in gaining a foothold in the stem and branches, and thus the combined effect of the poor growth conditions and the attack of the disease becomes cumulative.

The relation between the development of the disease and weather conditions during such a season as the past one is very obscure and probably very complicated. In previous reports it was stated that the spread of the disease occurs during wet weather, and there is considerable evidence that the major spread occurs during heavy storms rather than during periods of gentle showers. It is also known from past experience that both stem and branch lesions dry out and are cut off from the active tissues of the plant when subjected to periods of hot dry weather. In spite of these considerations, the alternating periods of heavy rainfall and hot dry weather during 1934 resulted in a heavy attack of Blackarm. During some, at least, of the dry periods the lesions remained in an active state and enlarged once more on the advent of moister weather. The number of lesions on the stem and branches of the plants was higher than in the previous year, indicating either a more rapid growth of the bacteria through the leaf petioles, or that the plants were unable to throw off their infected leaves as rapidly as in more normal seasons. The latter is the more probable, as in a season of poor growth conditions the plant is unable to make new growth at a rate sufficient to allow it to dispense with the infected leaves. It seems reasonable to expect that future seasons with similar alternating wet and dry periods will show higher incidence of Blackarm than seasons of more even rainfall, whether the latter be high or low.

At the moment considerable evidence is accumulating that this disease is becoming of increasing importance in some areas west of the Nile, especially in areas where rather low rainfall is combined with lighter soils. In the heavy red clay areas around Lake Victoria, with well distributed rainfall, the plants have hitherto shown little damage by Blackarm; though the disease occurs there, the plants appear able to withstand its attack and to throw it off, also to produce good crops in spite of it. Many cases have been noticed where the plants show a number of lesions comparable with the Teso counts, but are able to carry on and crop well, whereas in the latter district similar plants suffer severely and may produce little or nothing. This comparison is not strictly valid, on account of differences in the varieties of cotton grown in the two areas, but comparison of plots of S.G. 29 in the two areas indicates that the whole of the difference observed cannot be accounted for on the grounds of varietal differences in susceptibility to attack.

B. Wilt Disease (*? Fusarium vasinfectum*).

The incidence of this disease is definitely increasing in parts of Buganda Province around Lake Victoria. A few cases were discovered during the season in the districts east of the Nile, but the disease is very rare outside Busoga on this side. West of the Nile it is common in Mengo district, and worst in Masaka, where plots showing 20% infection or even more were seen in December. In Singo, towards Bunyoro, the disease is quite common on single plants or on small groups; in Bunyoro itself few cases were seen.

In each district there is some correlation between the incidence of Wilt and the sowing date of the cotton, but the correlation is not uniform. For instance, the Senior Botanist informed me that in Bulemezi he has not noticed the disease on plots sown before mid-June, but in Masaka district the early sowings show the highest infection, while the later sowings remained comparatively free at the time of my visit in December. At Bukalasa, where there are facilities for detailed observations, the disease is found to occur in patches and spreads out from the orginal site of infection. We have some evidence that it is able to recur after a rotation period of three years, and that it can spread in infected debris from a previous crop. The only cases observed at Serere occurred in 1933 on a variety grown from seed from Bukalasa, so that there is a possibility of seed transmission of this disease.

The early symptoms of the disease, as it occurs in Uganda, are very obscure. In acute cases the leaves show a sudden wilting, which is very characteristic; the tissues between the main veins turn first pale green and then light brown, dry up very rapidly and the leaves are shed. In many cases such infected plants die very rapidly and completely; but cases of at least partial recovery from the disease are quite common. These "recovered" plants produce a secondary foliage of small leaves and short branches, but very rarely recover sufficiently to produce any crop after wilting has once taken place. These cases of recovery are sufficiently common to make it evident that the attack is by no means always fatal.

A large number of plants were examined in Masaka district showing various leaf spots, chiefly due to *Alternaria* spp., and *Cercospora* spp.; in the majority of cases close examination of the wood of the basal part of the stem and of the roots showed that infection with *Fusarium* had taken place some time before. These plants, although showing a rather excessive amount of leaf shedding, showed no typical wilt symptoms as described above, but their growth was definitely retarded, and they bore very little crop. Usually the sudden wilting found in what may be termed acute cases of the disease occurs on well grown plants bearing a normal crop, whereas the "chronic" cases occur on slow growing plants and on plants suffering from drought. The symptoms shown by these chronic cases may be due to the attack or may be independent of this. On this point at the moment we have no evidence.

In the field the diagnosis of the disease is rather difficult, as while the acute cases are easily spotted from a distance, there is nothing to differentiate the chronic cases from plants suffering from other causes or diseases, except the internal streaks in the wood.

In view of the possible future importance of this disease in Buganda, attempts are being made by the Botanical staff to isolate resistant strains of cotton. Under Uganda conditions this seems the only possible means of control of a disease of this type.

C. Other Cotton Diseases.

In Masaka district a leaf spot due to *Alternaria* sp. was found associated with the attack of wilt disease in chronic form on affected plants. *Cercospora* leaf spot was also more prevalent on such plants than on others, except when these latter were obviously suffering from other causes, such as thin soil or drought.

The same *Alternaria* as that found in Masaka occurred at Serere on plants on two patches of land through an experimental manurial trial. Its incidence bore little or no relation to the manurial treatments, and is possibly associated with poor patches of rather shallow soil overlying ironstone. Many of the plants affected with this leaf spot at Serere showed attack by *Rhizoctonia bataticola* on the roots, and a large proportion eventually died. The *Rhizoctonia* in this case can hardly be considered as the primary cause of the trouble, as no success has been obtained by inoculations with this fungus on cotton much past the seedling stage. On the same plants Blackarm occurred to some extent, but not sufficient to account for the whole of the trouble.

Ramularia areola occurred in all districts whenever conditions became too moist; it appears to be more conspicuous on U. 4 derivatives, but except in very severe attacks little or no damage to the crop production of the plants appears to result. The disease quickly disappears after a few days of hot dry weather.

IV. Diseases of Other Crops.

Specimens of *Tea* leaves showing Scabbed Leaf Disease (non-parasitic), *Colletotrichum camelliae* and *Pestallozzia theae* were received from one estate, but these troubles have not yet occurred on the young leaves, so that for the present control measures are unnecessary.

Various leaf diseases of *Tobacco* have been received from time to time, including Angular Spot (*Bacterium angulatum*), *Cercospora* spp., Mosaic disease, and a number of leaf spots of unknown origin, some of which may prove to be due to infection by viruses. So far the Curly Leaf disease described in other parts of Africa has not been found on Uganda tobacco, though the white fly vector probably occurs here. Hitherto no serious disease has occurred to any important extent on the native tobacco crop of Bunyoro. On the Serere plot of imported tobacco varieties the stem disease caused by *Pythium* sp. ("Black Shank") occurred on a number of plants scattered through the plot. No definite indications of differences in the susceptibility of the varieties grown were noticed. The occurrence of this disease at Serere is of interest, as the tobacco in question was grown on land newly opened from grass, and has probably never been planted to this crop previously, certainly not within the last twelve years, during which period it has been under heavy grass and small bush. It would appear therefore that this fungus is a common inhabitant of the flora of some soils or patches of soil in Uganda, yet it has never been reported from Bunyoro. Its known distribution in Uganda is limited to the Government Plantations at Serere and Kampala.

The Mosaic disease of *Cassava* has become of considerable importance in some parts of Uganda, where this crop forms a major part of the reserve food supply for natives in time of famine. In Teso district infection is practically 100% on the long season variety in common cultivation, though the short season variety "Bitamisi" is more resistant and shows much less infection. The latter variety is not altogether suitable as a famine reserve on account of its short growing period. The present position in Teso is serious on account of the lack of healthy planting material. We have no information at the moment on the effect of the disease upon yield, except that it is known that when diseased cuttings are planted the yield is very low. The effect of "secondary" infection after the plants are established is not known. During the year advice was given in connection with the attempt to establish nurseries of clean plants throughout Teso district, to act as a source of healthy planting material. In some parts of Buganda the disease is liable to become even more important than in Teso, as in these areas cassava forms practically the only reserve food supply of the natives, whereas in Teso the native population has always some reserve of bulo (*Eleusine*). On the whole, however, the incidence of the disease in Buganda is much less than in Teso, and it appears that either the natives in the past have exercised more care in the selection of healthy material for planting, or that the rate of secondary spread of the disease by means of the insect vector is much slower under the moister conditions of Buganda. A number of imported varieties of cassava are available in very small quantities at the moment, and others are being imported from Amani Research Station for trial for resistance to infection, with the object of replacing the present susceptible stocks with more resistant or more tolerant strains.

A remarkable disease of *grafted coffee* occurred on the Kampala Plantation on a few trees. These showed abnormal thickening of the stem above the point of grafting, accompanied by longitudinal splitting of the bark in the same region and just below, to ground level. A number of fungi were found in the rotting bark, but none of them appear to be parasitic, or only weakly so. The first visible symptoms are the splitting of the bark, and this is sufficient to afford entry to any fungi in the soil capable of living in such situations. The bark after splitting is very subject to attack by insects, usually being completely ringed. Two cases were left *in situ* in an attempt to induce any *Polyporaceous* fungus in the tissues to fruit, but hitherto none has done so. Apart from fungus infection, it appears that there is some incompatibility between stock and scion in these trees, leading to excessive growth in thickness of the latter at the union, and to consequent strain on the bark of the stock just below. The trouble has been limited to about a dozen trees in one plot, and some of the

holes from which infected trees were removed have been filled with healthy Robusta seedlings to determine whether these will eventually become infected.

Jute at Kampala showed infection by *Heterodera radicicola, Cercospora* sp. and *Diplodia* (?) *corchori*. A small trial has been laid down to determine whether the disease is dependent on manurial factors; potash and phoshate manures have been used in the trial.

Boehmeria (ramie fibre) showed excessive defoliation in one plot at Kampala, caused by a species of *Cercospora*.

Pelargonium radula at Kampala suffered from the attack of *Pythium* sp., causing a black rot of the stem, and giving much trouble in the propagation frames.

Sugar cane showed infection by Red Stripe disease (*Phytomonas rubrilineans*). The variety P.O.J. 2727 showed heaviest infection, but the disease also occurred on P.O.J. 2878, P.O.J. 2725, Uba, and various other less important varieties. It is chiefly a disease of young canes, and many varieties show very good recovery from it as the plants develop. Advice was given against using infected material for planting, and every effort should be made to plant only healthy tops or canes. On another estate the disease has been controlled almost completely by roguing out infected canes at the same time as canes infected with Mosaic disease. The latter disease is of little importance at the moment, as most of the cane area of Uganda is planted with resistant or tolerant varieties. At the moment the predominating cane in Uganda is P.O.J. 2725, which grows and tillers strongly, is practically immune from Mosaic disease, more resistant to Red Stripe than other varieties, and gives a good tonnage in a short season. P.O.J. 2878 has proved less suited to Uganda conditions, where it takes much longer to mature than P.O.J. 2725, and gives no extra tonnage to compensate. Other varieties resistant to Mosaic have recently been imported and are being issued to estates for trial.

Hydnocarpus Wightiana and *Tea* at Entebbe showed infection of the roots by *Armillaria*; affected trees show the characteristic splitting of the roots and base of the stem caused by this fungus. The former was attacked at Kampala and Entebbe by a disease producing raised warts on the branches; these were confined to the bark tissues. The only fungus found in the scabs was a species of *Septoria*.

V. Miscellaneous.

Considerable time has been occupied with the statistical reduction of the data from various experiments in the Eastern Division.

In May a special report was made on the cultivation history of the various blocks of land on the old main farm at Serere, together with observations on their present condition and flora. The general conclusion drawn was that the system of continuous cropping on a regular rotation including cover crops and green manures has resulted in bad deterioration of the land, to a great extent due to excessive erosion of the surface layers of soil.

VI. Experimental Results.—District Variety Trials.

At the commencement of the cotton season it was decided to attempt to collect information on the behaviour of the newer cotton varieties with respect to Blackarm disease in particular, at all centres in the Eastern Division, and thus to extend the observational programme beyond the Serere stage, to which it had been limited in past seasons.

Two detailed examinations were made of all these trials, the first in September and the second in November-December, with the object of determining differences in varietal susceptibility to Blackarm attack, and the effect of sowing date and spacing on its incidence. The counts made in September were on the basis of the percentage of plants showing the disease in each plot, but after completion and analysis of these counts it was felt that additional weight should be given to the degree of infection on the plants, so that the December counts were made on the basis of the average number of lesions per plant on its main stem or large branches.

The varieties included in these counts have the following history :—

N. 17 ... An old type of Nyasaland cotton distributed over the Eastern Province, and since largely replaced by
S.G. 29 ... A more recent selection from Nyasaland.
S.P. 1 ... A selection from U. 4/4/2, from South Africa.
S.P. 20 ... A second generation selection from S.P. 1.

September: Percentage Infection with Angular Leaf Spot.

Centre.	S.G. 29.	N. 17.	S.P. 1.	S.P. 20.	L.S.D.†
Ngetta	67	75	65	67	—
Aduku	30	50	14	27	15·3
Kaberamaido	17	29	7	10	8·6
Nyero	96	100	69	76	8·7
Mbale	82	72	30	40	16·4
Mulanda	91	87	60	63	9·2
Vukula	76	77	40	50	10·9
Variety Means ...	65·3	69·9	40·4	47·5	4·6

† The contraction L.S.D.. is used in the above and subsequent tables for the Least Significant Difference (P. ·05).

NOTE.—The trial at Kibale showed complete infection of all varieties at this time; those at Bugaya, Bulopa and Wanyange were still very young, and were not counted for that reason.

The interaction Variety × Centre is significant in the above table; chiefly in that the resistance of the two U. 4 types is more prominent at some centres than at others.

SEPTEMBER: PERCENTAGE INFECTION WITH BLACKARM.

Centre.	S.G. 29.	N. 17.	S.P. 1.	S.P. 20.	L.S.D.
Ngetta	12·5	12·3	4·8	1·9	4·3
Aduku	3·0	4·1	0·0	0·5	2·0
Kaberamaido	13·8	8·7	1·2	0·6	4·8
Nyero	76·8	59·4	11·0	3·2	13·9
Mbale	14·0	7·5	0·9	0·7	8·9
Mulanda	16·7	20·1	2·0	3·2	8·6
Kibale	33·4	21·6	0·8	2·2	9·9
Vukula	4·7	4·8	0·8	1·4	2·6
Variety Means ...	21·9	17·3	1·7	2·7	2·5

The interaction Variety × Centre is significant in the above.

DECEMBER: BLACKARM LESIONS PER PLANT.

Centre.	S.G. 29.	N. 17.	S.P. 1.	S.P. 20.	L.S.D.
Ngetta	10·4	6·2	1·2	0·7	4·8
Aduku	4·3	3·7	0·6	0·6	0·7
Kaberamaido	7·8	5·6	0·7	0·8	0·6
Nyero	9·6	7·7	2·2	0·9	1·5
Mbale	5·8	3·2	0·6	0·7	0·6
Mulanda	8·7	5·8	1·2	1·4	0·8
Kibale	8·1	4·8	1·3	1·4	1·6
Vukula	6·4	4·3	1·1	0·6	1·2
Bugaya	0·8	0·8	0·2	0·2	0·2
Bulopa	2·7	1·5	0·4	0·5	0·7
Wanyange	0·6	1·0	0·2	0·2	0·6
Variety Means ...	5·93	4·06	0·89	0·73	0·29

The interaction Variety × Centre is significant: chiefly in that at the centres of heavy infection the resistance of the U. 4 types is more prominent.

On these tours of inspection the Mycologist was accompanied by the Assistant Entomologist, who made the following observations, which are included here for convenience.

SEPTEMBER: LYGUS DAMAGE TO THE LEAVES.

This was estimated for each plot by assessing the damage on each plant in the middle four rows on a scale of 0—9, and averaging for the plot.

Centre.	S.G. 29	N. 17	S.P. 1	S.P. 20	L.S.D.
Ngetta	6·47	6·82	5·74	5·84	0·53
Aduku	4·10	4·00	3·50	3·37	0·43
Kaberamaido	5·27	4·98	3·79	3·86	0·71
Nyero	6·43	6·79	5·00	4·75	0·61
Mbale	6·01	6·06	5·94	5·91	0·44
Mulanda	5·56	5·97	3·81	4·37	0·72
Kibale	5·87	6·05	5·03	5·18	0·45
Vukula	2·43	2·14	1·62	2·02	0·51
Variety Means ...	5·26	5·35	4·18	4·29	0·16

The interaction Variety × Centre is significant.

December: Jassid Nymph Counts.

In each plot the nymphs were counted on 10 leaves of each of 10 plants, and averaged per plant :—

Centre.	S.G. 29	N. 17	S.P. 1	S.P. 20	L.S.D.
Ngetta	0·63	1·33	0·75	0·83	...
Aduku	1·63	4·90	1·38	1·15	2·47
Kaberamaido	0·78	1·63	0·85	0·73	0·47
Nyero	2·43	3·15	2·05	2·30	...
Mbale	0·88	1·38	1·28	1·05	...
Mulanda	1·25	3·08	1·20	0·88	...
Kibale	1·58	1·25	1·58	2·05	0·32
Vukula	1·63	1·13	0·90	0·95	...
Variety Means ...	1·28	2·29	1·25	1·24	0·70

Katakwi Variety Trial.

Variety.	September Angular Leaf Spot %.	Blackarm %.	December Blackarm Lesions/plant.
S.G. 29	77·5	8·7	2·97
S.P. 1	37·2	...	0·36
S.P. 13 (from S.P. 1)	36·8	...	0·37
S.P. 20 (from S.P. 13)	54·2	1·2	0·50
S.P. 36 (" Nariama ")	41·5	0·6	0·41
S.P. 71 (from S.P. 36)	54·8	0·3	0·35
L.S.D.	17·9	3·0	0·72

Busoga Variety Trials—Bukalasa Varieties.

In September only the trial at Vukula was counted, the others containing only very young plants at this time :—

Variety.	Angular Leaf Spot %.	Blackarm %.	Lygus Damage.
B. 31	32·3	0·1	4·6
S.G. 23/8	91·5	3·6	4·5
Buganda Local	81·5	5·8	4·5
S.G. 29	84·3	3·2	4·1
L.S.D.	22·5	3·7	...

December Counts: Blackarm Lesions per Plant.

Centre.	B. 31	S.G. 23·8	S.G. 29	Buganda Local.	L.S.D.
Vukula	2·50	2·37	5·58	3·01	2·25
Bugaya	0·41	1·01	0·98	0·63	...
Bulopa	0·58	0·71	0·91	0·66	...
Wanyange	0·54	0·55	0·78	0·67	...
Variety Means ...	1·00	1·15	2·06	1·24	0·50

BUKALASA VARIETY TRIAL. DECEMBER: BLACKARM LESIONS PER PLANT.

Variety.	Mean.	L.S.D.
B.P. 52	6·48	
B.P. 49	5·40	
B.P. 58	3·95	
B.P. 50	3·90	1·04
S.G. 23·8	3·87	
B.P. 59	3·54	
B.P. 56	3·48	
Local	2·91	

VII. OTHER DISTRICT EXPERIMENTS.

MBALE—SOWING DATE AND SPACING TRIAL—Variety S.G. 29.

Sowing Date.	SEPTEMBER.		DECEMBER.
	Angular Leaf Spot %.	Blackarm %.	Blackarm Lesions per plant.
May	97	42	5·19
June	72	9	3·37
July	42	1	1·28
August	26	0	0·51
L.S.D.	14	10	0·95

The differences between the spacings were not significant in any of these counts; the spacings used were 6 ins., 12 ins., and 18 ins., by 3 ft. between the rows.

NGETTA—VARIETY AND SOWING DATE TRIAL.

	SEPTEMBER.		DECEMBER.
	Angular Leaf Spot %.	Blackarm %.	Blackarm Lesions per plant.
Varieties:—			
N. 17	72	46	6·03
SP. 1	59	21	1·31
L.S.D.	9·4	7·2	0·47
Sowing Dates:—			
April	51	48	4·19
May	80	41	3·86
June	66	11	2·95
L.S.D.	8·0	8·2	0·64

VIII. SERERE EXPERIMENTS.

During the past year work has been continued on the resistance of new varieties of cotton to Blackarm and other diseases, as compared with that of S.G. 29 as standard, and on the effect of seed disinfection with fungicidal dusts. A single comprehensive experiment was laid down, comprising the following treatments:—

Sowing Dates.—April.
May.
June.
July.

Seed Treatments.—
Dusted "Abavit B."
Dusted "Abavit New."
Control untreated.

Varieties.—

S.G. 29, as a control, being the present standard cotton variety over most of the Eastern Province.

S.P. 1, the original U. 4/4/2 selection.

S.P. 20, S.P. 21 } two 2nd generation selections from S.P. 1.

S.P. 48, a 3rd generation selection from S.P. 1.

S.P. 72, a representative of the latest generation of "Nariama" derivatives, originally selected in 1929 as being tolerant of Blackarm infection.

The experiment was arranged as a Latin Square of 4 by 4 Sowing Date blocks, divided at random into 3 sub-blocks for Seed Treatments, and again divided at random for Varieties.

(*a*) *Germination*, each plot being counted 10 days after sowing; treatment means being expressed as a percentage of possible plants.

Sowing Dates.		Seed Treatments.		Varieties.	
April	57·8	Control	49·0	S.G. 29	55·2
May	43·6	Abavit B	45·7	S.P. 72	50·9
June	31·5	Abavit New	45·2	S.P. 21	49·8
July	53·7			S.P. 48	44·5
				S.P. 20	43·2
				S.P. 1	36·2
L.S.D.	5·0		1·6		3·6

NOTE.—The seed of S.P. 1 was two years old, and this explains its lower germination.

(*b*) *Second Germination Counts.*—After the first counts the blank holes were resown, and a second count made 10 days later.

Sowing Dates.		Seed Treatments.		Varieties.	
April	83·1	Control	78·6	S.G. 29	82·2
May	80·9	Abavit B	77·3	S.P. 72	82·2
June	78·8	Abavit New	77·8	S.P. 21	82·2
July	68·9			S.P. 48	79·0
				S.P. 20	78·7
				S.P. 1	63·0
L.S.D.	4·0				2·8

(*c*) ANGULAR LEAF SPOT. PERCENTAGE INFECTED PLANTS.

	Weeks After Sowing.			
	10	13	16	20
Sowing Dates.—				
April	12·6	14·3	19·8	21·7
May	14·7	17·8	18·5	22·0
June	14·6	15·4	41·6	32·5
July	19·9	33·7	36·1	16·4
L.S.D.	...	13·9	10·4	10·5
Seed Treatments.—				
Control	32·4	37·7	46·7	34·7
Abavit B	7·2	11·2	19·0	18·0
Abavit New	6·8	12·1	21·3	17·7
L.S.D.	7·2	9·0	4·9	2·8
Varieties.—				
S.G. 29	29·7	44·8	57·2	55·6
S.P. 72	17·7	21·1	31·3	23·3
S.P. 20	15·4	18·0	26·3	16·5
S.P. 48	14·4	16·9	22·7	17·3
S.P. 1	7·3	12·9	21·2	19·1
S.P. 21	8·5	8·0	15·3	10·9
L.S.D.	4·1	3·2	5·3	6·0

(*d*) Angular Leaf Spot. Percentage Infection on October 8th.

Sowing Dates.		Seed Treatment.		Varieties.	
April ...	12·8	Control ...	40·1	S.G. 29 ...	60·3
May ...	22·0	Abavit B ...	20·1	S.P. 72 ...	29·9
June ...	41·6	Abavit New ...	22·2	S.P. 20 ...	21·6
July ...	33·7			S.P. 1 ...	20·4
				S.P. 48 ...	18·1
				S.P. 21 ...	14·6
L.S.D. ...	2·1	...	5·0	...	5·7

(*e*) Angular Leaf Spot. Infection Days.

The following table contains the treatment means, expressed as a percentage of the total possible infection days. The counts were made at regular intervals during the season, and at the end the total days each plant was infected were summed over the season, as in previous reports :—

Sowing dates.		Seed Treatments.		Varieties.	
April ...	13·0	Control ...	29·3	S.G. 29 ...	36·0
May ...	14·1	Abavit B ...	10·9	S.P. 72 ...	18·2
June ...	23·3	Abavit New ...	11·7	S.P. 48 ...	14·6
July ...	19·0			S.P. 20 ...	14·6
				S.P. 1 ...	12·0
				S.P. 21 ...	8·6
L.S.D. ...	6·5	...	1·8	...	2·8

(*f*) Blackarm Infection. Percentage Infected Plants.

	Weeks After Sowing.		November 13th.
	14	17	
Sowing Dates.—			
April	2·28	4·63	19·60
May	1·36	4·40	17·00
June	1·01	6·77	14·95
July	1·21	4·92	4·92
L.S.D.	...	...	5·11
Seed Treatments.—			
Control	2·09	6·69	16·20
Abavit B	1·42	4·40	13·22
Abavit New	0·94	4·45	13·97
L.S.D.	0·70	1·39	1·97
Varieties.—			
S.G. 29	3·70	14·23	35·15
S.P. 72	1·52	7·80	15·61
S.P. 1	1·04	2·77	12·30
S.P. 20	0·83	2·23	7·58
S.P. 21	0·83	2·18	7·29
S.P. 48	0·90	1·83	8·87
L.S.D.	0·44	2·19	3·16

(*g*) Blackarm Infection Days.

Calculated as Angular Leaf Spot Infection Days above.

Sowing Dates.		Seed Treatments.		Varieties.	
April ...	8·0	Control ...	7·9	S.G. 29 ...	16·4
May ...	8·5	Abavit B ...	6·4	S.P. 72 ...	8·6
June ...	7·7	Abavit New ...	6·5	S.P. 1 ...	5·4
July ...	3·5			S.P. 48 ...	4·0
				S.P. 20 ...	3·8
				S.P. 21 ...	3·4
L.S.D. ...	2·2	...	0·7	...	1·4

The interaction Variety × Sowing Date is significant, chiefly in that S.P. 72 showed low infection in the July sowings.

(*h*) Blackarm Lesion Count, November.

It was felt that the above table of "Blackarm Infection Days" does not give altogether a true picture of differences in incidence of the disease, as every plant showing even a trace of the disease is included therein, and no distinction is made between differences in degree of attack on the plants. A count was made during November of the actual number of Blackarm lesions on each of 50 plants in each of the 288 plots of the experiment; the treatment means of lesions per plant are given below:—

Sowing Dates.		Seed Treatments.		Varieties.	
April ...	4·06	Control ...	2·23	S.G. 29 ...	4·60
May ...	1·98	Abavit B ...	1·93	S.P. 72 ...	3·12
June ...	1·52	Abavit New ...	1·91	S.P. 1 ...	1·26
July ...	0·54			S.P. 20 ...	1·17
				S.P. 48 ...	1·03
				S.P. 21 ...	0·96
L.S.D. ...	0·62	...	0·22	...	0·27

The interaction Variety × Sowing Date is significant in the above table, chiefly in that the differences between the Nyasaland cottons (S.G. 29 and S.P. 72) and the U. 4/4/2 derivatives (the four other varieties) are accentuated on the older plants (earlier sowings); while the difference S.G. 29—S.P. 72 is less on the same sowings.

(*j*) Jassid Nymph Counts.

These were made by the Entomological staff, and are included here for convenience of presentation. They were made on the basis of the number of nymphs found on 10 leaves of each of 10 plants selected at random from each plot, and averaged per plant. It is probable that this sample is too small for accuracy of the degree required; but the amount of damage to the foliage of the plants caused by the examination of a larger sample has to be taken into consideration in the case of trials of this nature, designed primarily for yield tests.

The first count was made on 8th August, on the three earlier sowings only, as the July sowings were then too young to be worth while counting. Only differences between varieties were found to be significant when this count was analysed:—

Variety Means:			
S.P. 72	7·35		
S.G. 29	4·63		
S.P. 48	4·18	L.S.D. ...	0·60
S.P. 1	4·15		
S.P. 20	4·03		
S.P. 21	3·85		

The second count was made on November 16th to 19th over the whole 288 plots of the trial. Again, only variety differences were significant:—

S.P. 72	5·13		
S.G. 29	3·63		
S.P. 1	3·24	L.S.D. ...	0·59
S.P. 21	3·24		
S.P. 20	2·93		
S.P. 48	2·89		

(k) Leaf Reddening.

In connection with the above Jassid nymph counts, an attempt was made to correlate the number of Jassids found on the plants with the leaf reddening shown by them. No attempt was made to differentiate between the various types of leaf reddening found, which were all included in the counts. These were made on the basis of an estimate of the degree of reddening shown by a sample of some 50 plants per plot, and averaged for the plot; the reddening was estimated on a decimal scale.

The results were analysed by the method of co-variance:—

Sowing Date.—The earlier sowings show more reddening and more Jassids (*r* is +·956);

Seed Treatments.—Had no effect on either variate, and the correlation coefficient was not significant.

Varieties.—Those with the highest Jassid counts showed most reddening (*r* is +·7907).

Residual Correlation is +·0665, and is not significant; we infer that there is nothing in the figures under consideration to indicate that Jassids are the major cause of the total reddening observed.

(l) Lygus Damage Counts.

These were made by the Entomological staff, the damage being assessed on the four middle rows of each plot. On each individual plant the leaf damage was estimated on a scale of 0 to 9, and these estimates were averaged for the plot.

In this case the age of plant has a large effect upon the amount of damage, which is slight in the early stages of growth, later rising to a maximum, and then falling off as the plants get older and recover from the attack. In the following tables the figures represent mean damage on the above scale, at 11 to 12 weeks after sowing; thus the effect of age of plant is eliminated, and the differences shown by the sowing dates represent the effect of differences in environment, probably chiefly climatic factors.

Variety.	April.	May.	June.	July.	Variety Means.
S.G. 29	1·77	2·53	2·66	2·19	2·29
S.P. 72	1·38	2·33	2·56	2·36	2·16
S.P. 1	1·59	1·96	2·43	2·18	2·04
S.P. 20	1·49	1·93	2·24	1·97	1·91
S.P. 48	1·32	2·01	2·14	1·99	1·87
S.P. 21	1·27	1·97	2·16	2·03	1·86
Sowing Date Means ...	1·47	2·12	2·35	2·12	...

L.S.D. between Variety Means is 0·11. L.S.D. between Sowing Date Means is 0·33.

The interaction Variety × Sowing Date is significant.

There was no significant effect due to seed treatment, as would be expected.

(m) Yield.

The yield figures and the results of analysis appear in the report of the Assistant Botanist, Serere.

(n) Correlation of Yield with Diseases, etc.

The following correlation coefficients were obtained as residuals after analysis by the method of co-variance; those in italics are significant.

Varieties.	Whole Trial.	S.G. 29.	S.P. 1	S.P. 20.	S.P. 21.	S.P. 48.	S.P. 72.
Yield × Stand	+·1304	+·0051	+·1140	—·0958	+·*4226*	+·0381	+·1644
Yield × Lygus	—·0441	—·0143	—·1332	—·3401	—·1681	+·*4451*	—·*4960*
Yield × Jassid	—·1063	—·0627	+·*6982*	—·0761	—·1945	+·1909	—·*6604*
Yield × Angular Leaf Spot	+·0425	—·2648	+·2192	—·0589	+·3834	+·*4325*	—·0083
Yield × Blackarm ..	—·0817	—·1285	+·1817	—·0601	+·2852	+·1728	—·0611
Stand × Lygus	—·*1925*						
Stand × Jassid	—·0485	—·0718	+·0308	+·0415	—·0335	—·1118	+·0685
Stand × Angular Leaf Spot	+·0610	—·0368	—·0151	+·3350	+·1036	—·0768	+·0503
Stand × Blackarm ..	—·0130	+·1032	+·1422	+·1910	+·3696	—·0353	+·1465
Lygus × Jassid	+·0652	—·0267	—·1907	+·2281	—·2652	+·0847	+·*4995*
Lygus × Angular Leaf Spot	+·0727	—·0437	—·1242	—·0005	+·1813	—·1410	+·0066
Lygus × Blackarm ..	+·*1914*	—·0129	+·*3894*	+·0245	—·*4376*	—·1213	+·0395
Jassid × Angular Leaf Spot	+·0336	+·1999	—·2528	+·0470	—·1365	—·1872	—·1105
Jassid × Blackarm ..	+·1040	+·1380	—·0657	—·1632	—·0325	+·1660	+·2570
Angular Leaf Spot × Blackarm.	+·1109	+·*8412*	+·3463	+·1073	+·0740	+·*5032*	+·*6665*

The effect of differences in Sowing Date, Seed Treatment and Variety on the relationship of the above variates is given below; the coefficients were obtained by the method of co-variance:—

Variates.	Sowing Dates.	Seed Treatments.	Varieties.
Yield × Stand	—·*978*	—·697	—·044
Yield × Lygus	+·820	—·674	—·*962*
Yield × Jassid	+·186	+·306	—·*763*
Yield × Angular Leaf Spot ...	+·*985*	—·850	—·*760*
Yield × Blackarm	—·180	—·868	—·*875*
Lygus × Stand	—·870	—·071	—·137
Jassid × Stand	—·362	+·411	+·124
Stand × Angular Leaf Spot ...	—·*988*	+·213	+·166
Stand × Blackarm	+·342	+·250	+·058
Lygus × Jassid	+·259	—·*934*	+·*622*
Lygus × Angular Leaf Spot ...	+·786	+·*963*	+·*844*
Lygus × Blackarm	—·192	+·*952*	+·*938*
Jassid × Angular Leaf Spot ...	+·344	—·803	+·266
Jassid × Blackarm	—·*995*	—·779	+·426
Angular Leaf Spot × Blackarm ...	—·341	+·*999*	+·*963*

The coefficients in italics above are significant; the Variety column is the most important to us, as for example, the figure —·962 in this column for Yield × Lygus, indicates that varieties having most Lygus damage tend to yield lower than varieties with less infection by this insect.

IX. Serere Cotton Breeding Plot.

Detailed examinations were made of all individual plants in this plot, at regular intervals from August to November. The amount of Angular Leaf Spot on each plant was estimated as in previous years, and the actual number of Blackarm lesions was recorded for each plant. These counts have now been included in the regular routine for each season, and varieties showing high counts are discarded.

X. Summary of Cotton Observations.

The most outstanding result of the work carried out during the last three seasons is the proof of the high resistance of most of the derivatives of U. 4/4/2 to Blackarm. This resistance is inherited by the later generations of this group of varieties, but rigid selection for this character is important, as some selections show greater susceptibility than others. At Bukalasa one strain of this family showed extreme susceptibility to Blackarm, of a higher degree than even the Nyasaland cottons, which are usually considered here as being very susceptible.

The effect of Blackarm on yield is very complicated, and throughout the work one of the chief difficulties has been to arrive at a figure which will represent to some extent the amount of Blackarm on the plant throughout the season. It has become obvious as the work progressed, that the effect of this disease is the sum of a number of factors, of which the following are the most important:—

(i) *Date of Infection.*—It is obvious that, other things being equal, early infection should have more effect on yield than infection late in the season. Therefore in the present work the variate "Blackarm Infection Days" has been used to include this effect.

(ii) *Amount of Infection.*—The actual number of lesions on the plant.

(iii) *Site of Infection.*—As a rule infections on the main stem and larger branches are the most important.

(iv) *Size of Plant in Relation to Amount of Infection.*—On a large vigorous plant a definite number of lesions will have less effect than the same number on a smaller plant.

(v) *Weather Conditions.*—The duration of the activity and the rate of enlargement of the lesions depend largely on climatic factors.

(vi) *Varietal Susceptibility.*

In the present work, "Blackarm Infection Days" has been used as an index of infection; but this variate does not include the effect of several of the above factors, notably site of infection and number of lesions per plant. To a certain extent this variate does not give a true picture of even the date of infection, as it is quite possible for a variety to become infected with a large number of lesions late in the season, when the effect on yield is

obviously minimised, and at the same time show a higher figure for "Blackarm Infection Days" than another variety on which a fewer number of plants were infected quite early in the season and possibly even killed out by such infection. To avoid such a difficulty the summation of " Blackarm Infection Days " was carried only to December 1st, and infection after that date was ignored as being of less importance.

It appears almost impossible to hope for any numerical index of site of infection. In the present experiment, the mere counting of plants showing infection, over 288 plots of 280 plants each, has proved very laborious, and further detail in the counts appears impracticable. It was found impossible to do even the simple count mentioned more often than once every two or three weeks. Also, the effect of excessive trampling of the land, and handling of the plants has to be considered in an experiment in which, after all, yield figures are the most important.

A single count was made of the actual number of lesions per plant, over a sample of 50 plants in each plot. This proved very slow work, and its accuracy is not above question, as most of the plots were counted by native observers, who find it difficult to diagnose the lesions with certainty.

In spite of all the records obtained from the experiment, the correlation between these and the yield figures was disappointingly low. The disinfection of the seed with the two dusts used resulted in a very significant reduction in Angular Leaf Spot infection, and also in Blackarm infection, but no significant differences were found in the yields of the controls and the dusted plots. On the other hand, the differences observed in the yield of the varieties used in the trial were closely correlated with their relative resistance to disease and insect attack.

C. G. HANSFORD,

Mycologist.

ANNUAL REPORT OF THE AGRICULTURAL CHEMIST.

Staff Movements.

The Agricultural Chemist attended the Conference on Co-ordination of Agricultural Research and Plant Protection at Amani in February and the Soil Chemists' Conference at Zanzibar in August. The proceedings of these Conferences have already been published.

The Agricultural Chemist also attended the Kenya Coffee Days at Nairobi in July, during the course of which he demonstrated mulching.

Local travelling included a visit to the Eastern Province by the Agricultural Chemist and to Bulemezi and Buruli by the Assistant Agricultural Chemist.

Summary of Laboratory Work.

The following is a summary of work carried out in the laboratory during the year:—

Soils:	
Re-action	96
Moisture at sticky point	88
Loss on Ignition	90
Nitrogen (total)	159
Nitrates	540
Moisture	546
Available Phosphate	56
„ Potash	72
„ Calcium	85
Other Work:	
Beeswax acid values	12
Essential oils	10
Fibre extractions	25
Coffee moisture	57

Erosion and Regeneration.

The section continues to take an active part in the anti-erosional schemes and methods of regeneration upon which the attention of the Department has been focussed

In the Annual Report of the Agricultural Chemist for 1930 an experiment was described which was begun at Serere in that year, to compare the value of—

(*a*) *Cajanus indicus* contour hedge,
(*b*) Lemon grass contour hedge,
(*c*) Surface contour drains,

as erosion checks.

The experiment was in the form of four randomised blocks, each block consisting of the above three treatments and a control plot (untreated). Each plot is a strip measuring 9 by 100 yards with the long side down the slope. Each strip is divided by its treatment into three subplots of 100 feet in length.

The subplots were sampled separately in 1930 and again this year. It was the original intention to carry out mechanical analyses and organic matter determinations on all the samples but it was found impossible to carry out the former and determinations of the moisture at the point of stickiness were made instead. These give a measure of the colloid content of the soil. Organic nitrogen determinations were made as a measure of the organic matter.

The following table gives the average of these determinations on each subplot.

Treatment.	Subplot.	Moisture at point of stickiness.		Organic Nitrogen.	
		1930.	1934.	1930.	1934.
Cajanus Indicus contour hedge ...	Top ...	21·1	19·3	0·086	0·069
	Middle ...	22·6	19·5	0·090	0·064
	Bottom ...	21·9	19·5	0·103	0·073
Lemon Grass contour hedge ...	Top ...	20·3	20·0	0·095	0·077
	Middle ...	21·3	20·0	0·094	0·079
	Bottom ...	20·8	19·2	0·091	0·083
Surface Contour Drains ...	Top ...	20·5	19·3	0·088	0·060
	Middle ...	21·8	19·8	0·107	0·067
	Bottom ...	21·1	19·8	0·094	0·069
Control	Top ...	20·8	19·5	0·090	0·080
	Middle ...	20·5	19·9	0·082	0·085
	Bottom ...	21·5	19·6	0·084	0·074

These figures show clearly a reduction in the moisture at point of stickiness (implying a loss of colloidal matter) and in the organic nitrogen. This reduction is common to all plots, however, and is not greatest on the control plot.

Yield figures for the crops grown on this experiment showed also on statistical examination no benefit from any of the treatments. The only statistically significant result was that the bottom subplot of each strip gave the best yields and the middle plots gave in each case significantly higher yields than the top plots. It would appear that in this case anti-erosional methods were not introduced in time. Erosion takes place at an increasing rate once the surface soil has started to move and the conclusion would appear to be that in this case the soil had already been too extensively eroded for the beneficial effect of the treatments to apply.

In the light of this and of other increasing experience a comprehensive scheme of experiment in anti-erosional methods has been devised and will shortly be put into operation.

In the meantime the natives are everywhere being actively encouraged to plant their crops along the contour and to mulch permanent crops. It is also the growing practice to leave rubbish in rows between the cotton and to leave the land as rough as possible when planted.

Experiments have been begun at many centres to investigate the possibility of accelerating the regeneration of exhausted land. With the present growing pressure of agricultural activity the native system of fallowing does not result in a sufficiently rapid recovery of the land. In elephant grass country the effect is being tried of planting elephant grass on abandoned land instead of waiting for the natural succession. When this has been done an excellent stand of elephant grass has developed in a few months. During 1935 one such experiment, at Bukalasa, will mature; the grass will then be removed and the rested land tested by cropping. At Kampala also the effects of elephant grass and of *Centrosema pubescens* for regeneration purposes are being compared.

Observations are also being made at all centres on the natural ecological succession on exhausted land, the growth and root spread of various grasses and legumes, and their drought resisting qualities.

In Teso the position is aggravated by the increasing number of cattle with the consequent danger of increasing erosion by overgrazing. There the natives are being encouraged to house their cattle properly and to make cattle manure. Meanwhile, different methods of storing cattle manure are being tried at Bukalasa and Serere, accompanied by analyses of the products and by field trials, in order that the most economical method of manufacture may be recommended.

Field Experiments on Coffee.

A. Comparison of Local Fertilizing Materials with Niciphos.

This is in the form of a 6 by 6 Latin square comprising the following treatments on *C. arabica*:—

A ... Cotton seed, 3 tons per acre.
B ... No treatment.
C .. Meraco bone meal, 10 cwts. per acre.
D ... Green manure.
E ... Mulch.
F ... Niciphos, 240 lbs. per acre.

Yields in Cwts. of Cherry per Acre.

Treatment	1933	1934	Mean.
A	17·00	50·43	33·71
B	11·97	39·30	25·63
C	17·12	43·71	30·42
D	13·02	38·45	25·74
E	15·60	51·11	33·35
F	15·63	48·10	31·86
Significant Difference ...	4·18	7·83	2·11

Interaction Treatment and Season is significant. E shows better in the second year and C has fallen off.

The no treatment and green manure plots are definitely the worst. Cotton seed and mulch are significantly better than the Meraco but the difference between these treatments and Niciphos is not significant.

In this experiment the trees suffered very badly from *Hemeleia* and dieback but the damage was less severe on the mulched plots. As most of the trees in the other plots will have to be severely pruned and in some cases stumped, the experiment has now been discontinued as the uniformity trial yields of 1932 can no longer be said to reflect the state of the plot. It is evident that the mulch application enabled the trees to carry their crop much better than any other treatment.

B. Comparison of Complete Mulching and Alternate Line Mulching.

This is in the form of a 5 by 5 Latin square comprising the following treatments on C. arabica:—

A ... Complete mulching with long grass.
B ... Alternate line mulching with chaffed grass.
C ... No treatment.
D ... Complete mulching with chaffed grass.
E ... Alternate line mulching with long grass.

Mean Yields of Cherry in Cwts. per Acre.

Treatment.	1933.	1934.	Mean 1933 and 1934.
A	9·2	21·0	15·1
B	4·8	11·7	8·24
C	4·0	11·2	7·57
D	5·4	15·7	10·53
E	6·0	18·5	12·25
Significant Difference ...	2·7	6·7	3·79

Complete mulching with long grass is significantly better than the control and both chaffed mulches. Alternate line mulching with long grass is better than the control and than alternate line chaffed mulch. It is evident, therefore, that nothing is gained by chaffing the grass especially as it doubles the cost of the mulch. There appears to be a tendency for the alternate line long grass mulch to overtake the complete mulch. It remains to be seen whether this tendency will be maintained in the 1935 crop.

C. One of the Toro experiments on artificials has now completed five years. The treatments were as follows, in the form of a 6 by 6 Latin square on C. arabica:—

A ... Niciphos, 240 lbs. per acre.
B ... Superphosphate, 2 cwts. per acre.
C ... Sulphate of Potash, 2 cwts. per acre.
D ... Sulphate of Potash, 2 cwts. per acre.
Niciphos, 240 lbs. per acre.
E ... Sulphate of Potash, 2 cwts.
Superphosphate, 2 cwts.
F ... No treatment.

The following is the analysis of yield data:—

Mean Yields in Cwts. of Cherry per Acre.

Treatment.	1930.	1931.	1932.	1933.	1934.	Mean.
A	16·4	80·4	54·4	13·2	64·8	45·83
B	15·8	52·9	50·0	8·9	58·7	37·22
C	11·5	47·2	47·8	7·3	54·9	33·75
D	11·6	61·4	56·1	8·2	59·2	39·31
E	16·0	59·1	48·8	11·8	65·5	39·44
F	13·9	52·2	46·7	7·8	59·3	35·96
Mean Lowest ...	14·19	58·87	50·64	9·52	59·72	38·59
Significant Difference	...	6·30	...	2·42	...	5·27

The only treatment, therefore, which gives an increase in yield complying with the statistical test is Niciphos alone. Niciphos in combination with Sulphate of Potash has not given a significant increase.

D. The Effect of Different Ground Treatments on Soil Conditions Affecting Coffee Growth.

This experiment, which is being run in collaboration with the Assistant Botanist, has now completed over eighteen months. The Assistant Botanist in his report refers to the present appearance of the plots and to the temperatures of the soil on the different plots. The chart facing page 92 shows the fluctuations of nitrate and moisture content over the period of the experiment.

The experiment comprised four plots of native Robusta coffee under the following treatments:—

Clean weeded, cover crop, weeds slashed, and mulch.

Observations were also made on on a neighbouring Arabica plot growing under shade The slashed plot has been omitted from the present curves for the sake of clarity as it. falls between the nitrate curve for the clean weeded and the cover crop plots, which for the last twelve months have run close together.

Nitrate and moisture content were determined fortnightly on each plot at three depths, 0—4", 4—8" and 8—12". In the present curves the figures for the three depths have been averaged as they all fall into the same relative order of treatments.

DISCUSSION OF THE CURVES.

Moisture.

Clean Weeded.—The moisture does not rise as high and falls lower than any of the other plots. This points to greater run off during rain and quicker drying out.

Cover crop.—At the beginning, before the cover crop had become established, there was considerable drying out, which no longer takes place.

Mulch.—The moisture content has only once fallen below 16% in the course of 20 months.

Shade.—The moisture content does not rise as high as on the mulched and cover crop plots and tends to fall lower.

Nitrate.

Clean Weeded.—The nitrate content showed for some time a marked superiority over mulch and cover crop. This advantage has now been lost.

Cover crop.—On this plot the nitrate content has been considerably the lowest.

Mulch.—The nitrate content has never been high but has kept at a steady level and is now higher than on the clean weeded and cover crop plots.

Shade.—The nitrate content has throughout been much higher on this plot.

Connection Between Moisture and Nitrate Content.

Care must be exercised in drawing conclusions from the present curves as they represent measurements taken at fortnightly intervals and are therefore unlikely to represent the true maxima and minima. There does, however, appear to be a definite tendency for a rise in nitrate content to follow a rise in moisture content. A complete discussion will be left to a future publication when the above observations will be correlated with those made by the Assistant Botanist.

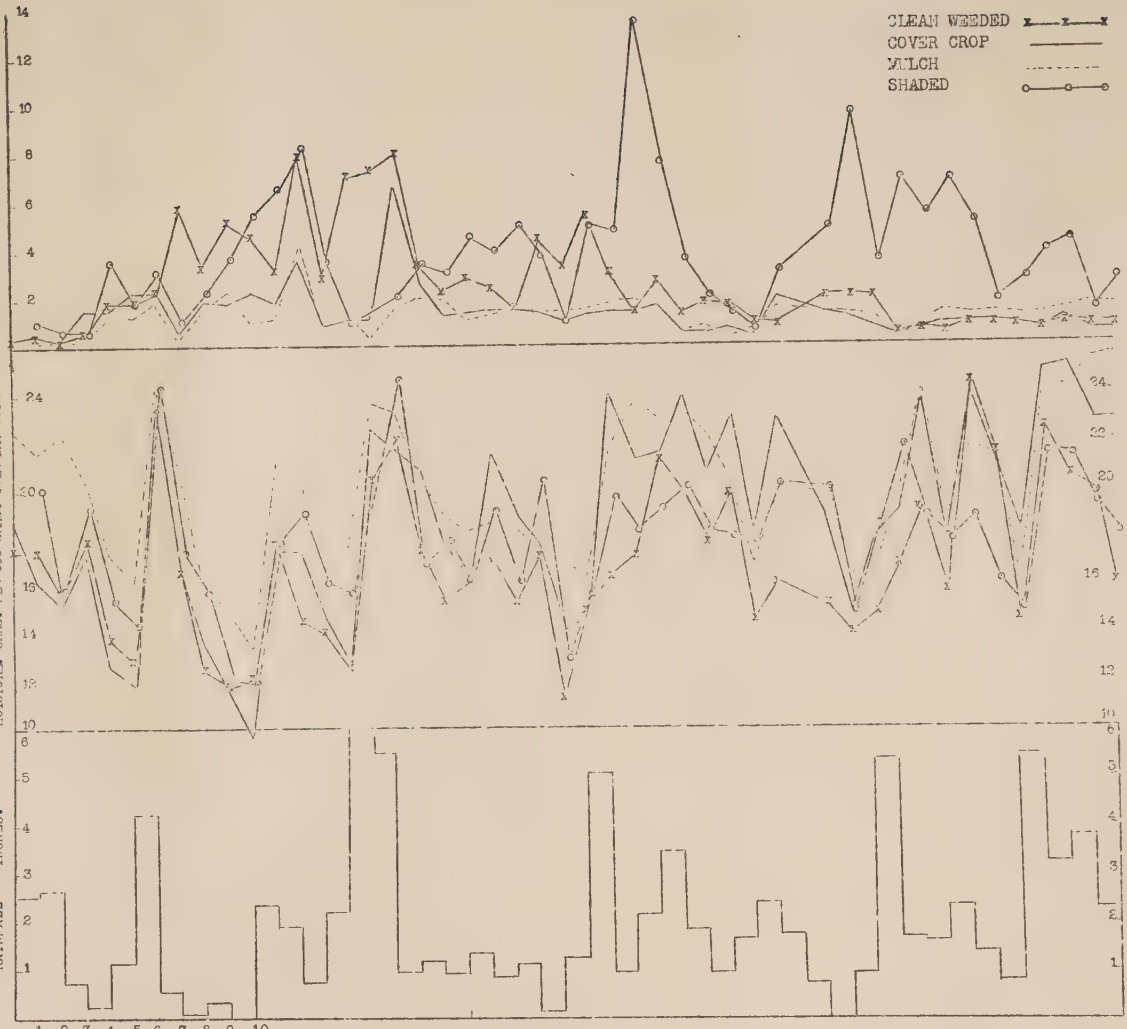
Experiments on Moisture Content of Coffee.

As has been reported in previous years, a moisture content not exceeding 12·5% has been demanded of Uganda coffee appearing on the Nairobi market in order to ensure immunity from *Stephanoderes*. During the year the question arose as to how the planter could satisfy himself that his coffee contained no more than the specified amount of moisture.

A simple apparatus was devised for the purpose. This consisted of a petrol tin cut down to half size and containing water. The coffee to be tested is spread in a thin layer on the lid and the whole heated on an open fire. It was found that 7 oz. of coffee treated in this manner should not lose more than ½ oz. in weight after four hours simmering if the initial moisture content were not more than 12·5%.

Field Experiments on Cotton.

A large scale experiment was conducted this year, designed to give information on the effect of soil and climate in relation to damage done by certain insects (Lygus and Jassid) and Blackarm to different varieties of cotton. For this purpose plots of the different varieties were planted at chosen sites over the whole of the Eastern and Western Divisions. Meteorological records were kept and the insect damage was recorded by the Entomologist.


CLEAN WEEDED
COVER CROP
MULCH
SHADED
NITRATE. MGMS.PER 100 GMS.OVEN DRY SOIL.
MOISTURE GMS. PER 100 GMS. OVEN DRY SOIL.
RAINFALL INCHES.
1 2 3 4 5 6 7 8 9 10
FORTNIGHTLY INTERVALS FROM SEPTEMBER 21st 1933 TO JUNE 30th 1935.

Summary of Insect Damage, Yield and Data on Soils of the Soil Climate Insect Attack Experiment.

Locality.	Lygus.	Jassid.	Blackarm.	Total Yield of Cotton in Lbs.	Depth.	Reaction.	Moisture at Point of Stickness.	Loss on Ignition.	Organic Carbon	Organic Nitrogen.	C/N RATIO.	AVAILABLE NUTRIENTS. % sol. in N/2 Acetic Acid.		
												P_2O_5	K_2O	CaO
Kiboga	0·32	0·8	1·88	—	Top	Neutral ...	27·6	7·6	1·74	0·170	10·2	0·00269	0·0447	0·225
					Sub	Acid ...	26·5	6·3	0·74	0·078	9·5	0·00086	0·0374	0·033
Bulopa	0·57	1·6	2·38	37·1	0—6″	Acid ...	23·8	10·5	1·90	0·168	11·3	0·00166	0·0262	0·181
					6—12″	Acid ...	30·2	9·9	1·52	0·128	11·9	0·00162	0·0187	0·141
Kyanamukaka ...	0·70	—	0·13	—	Top	Slightly Acid	23·8	7·1	1·45	0·137	10·6	0·00183	0·0320	0·149
					Sub	Acid ...	22·8	6·4	1·12	0·072	15·6	0·00157	0·0523	0·156
Nakasongola ...	0·82	0·3	2·06		Top	Neutral ...	20·5	5·2	1·07	0·088	12·2	0·00291	0·0266	0·276
					Sub	Acid ...	21·2	5·3	0·70	0·070	10·0	0·00128	0·0361	0·077
Bugaya	0·89	2·0	—	15·6	0—6″	Acid ...	29·7	9·5	1·11	0·097	11·4	0·00170	0·0270	0·123
					6—12″	Acid ...	34·2	9·5	0·85	0·084	10·1	0·00145	0·0149	0·065
Wanyan	2·08	2·2	1·02	58·0	0—9″	Neutral ...	38·2	13·3	2·03	0·240	8·5	0·0308	0·0545	0·643
					9—15″	Neutral ...	35·7	11·1	1·24	0·160	7·8	0·0174	0·0456	0·431
Katakwi	2·09	1·7	—	—	0—4″	Acid ...	14·8	3·3	0·49	0·043	11·4	Less Than	0·0025	0·091
					4—9″	Acid ...	18·2	4·5	0·47	0·047	10·0	0·001	0·0199	0·106
Simsa	2·22	—	4·48	—	0—6″	Acid ...	15·7	3·8	0·46	0·043	10·7	0·00172	0·0145	0·120
					6—12″	Acid ...	21·5	6·3	0·65	0·057	11·4	0·00182	0·0149	0·138
Bulindi	2·30	0·4	9·00	—	0—6″	Neutral ...	37·8	13·4	2·59	0·237	10·9	0·00149	0·0373	0·381
					6—12″	Neutral ...	36·5	12·7	1·71	0·159	10·8	0·00141	0·0141	0·268
Vukula	2·38	2·0	4·06	48·4	Top	Acid ...	20·2	4·7	1·23	0·093	13·4	0·00226	0·0208	0·276
					Sub	Acid ...	21·0	5·0	1·01	0·078	13·0	0·00167	0·0071	0·282
Aduku	4·92	1·9	4·28	48·7	0—8″	Slightly Acid	25·1	7·5	1·33	0·135	10·2	Less Than	0·0266	0·152
					8—18″	Acid ...	26·5	8·0	0·57	0·055	10·4	0·001	0·0166	0·120
Kaberamaido ...	5·27	1·6	7·60	34·3	Top	Slightly Acid	29·4	8·9	1·65	0·139	11·9	0·00556	0·0526	0·332
Nyero	5·55	2·5	7·18	16·5	0—5″	Acid ...	17·7	4·3	0·61	0·057	10·7	0·00145	0·0228	0·124
					5—12″	Acid ...	15·8	3·5	0·68	0·056	12·1	0·00202	0·0270	0·121
Kibale	5·87	1·6	8·92	34·4	Top	Acid ...	19·1	4·8	0·79	0·071	11·1	0·00120	0·0183	0·013
Mbale	6·29	1·5	6·02	94·00	0—6″	Slightly Acid	44·9	14·4	3·88	0·247	15·7	0·0619	0·1061	0·989
					6—12″	Acid ...	46·2	13·2	2·58	0·178	14·5	0·0417	0·0456	0·715
Mulanda	6·37	2·0	7·8	41·2	0—6″	Neutral ...	15·1	2·2	0·45	0·044	10·2	0·0135	0·0324	0·196
					6—12″	Neutral ...	14·3	1·9	0·85			0·0109	0·0307	0·136
Ngetta	6·52	1·8	8·94	29·3	Top	Slightly Acid	17·8	5·3	1·08	0·069	15·6	0·00175	0·0292	0·149

The figures in the first four columns refer to variety S.G. 29.

Soil samples were taken from each centre and analysed for easily soluble potash, calcium and phosphate. Organic matter (carbon and nitrogen), moisture at point of stickiness, and reaction were also determined. (The soil data are included as they are of interest in themselves in showing upon what a wide variety of soils cotton is growing in Uganda. Thus we range from Katakwi and Simsa with a soil that is little more than sand to Mbale with a heavy soil very rich in plant foods.)

As far as the object of the experiment is concerned, however, there is nothing to conclude from the data. In the table the centres are arranged in ascending order of Lygus attack (which agrees remarkably well with the same order of Blackarm attack). The figures given are for S.G. 29. Not one of the soil properties tabulated shows any indication of following this order.

The results of the experiment are still under consideration, changes in the Entomological staff having resulted in delay in assembling the available data. It may be that when all factors are taken into account some soil property working in conjunction with an external factor may prove to be decisive. It is, perhaps, unfortunate that in the present series of observations no record was kept of the size of the plants examined. It would appear that in the absence of such records insect counts, or counts of damage, are incomplete as the anomaly arises that a large healthy plant may show a greater total of damage than a small one.

Soils.

During the course of the year a large number of soils have been examined in the field and in the laboratory. Some very interesting series of profiles have been sent in by Agricultural Officers and the examination of these together with the large number of samples already accumulated and also of those taken for the investigation of specific problems has enabled us to prepare a preliminary soil map which, with a short descriptive memorandum, was presented at the Soil Chemists' Conference at Zanzibar.

It was there decided that the Amani Soil Chemist should co-ordinate the maps of the northern territories of the East African group and present the complete map at the Third International Congress of Soil Science at Oxford in 1935.

The routine examination of soils has been continued and the data now available on the easily soluble potash, calcium, and phosphate, lend further support to the suggestion made in last year's report that phosphate is a probable limiting factor in many districts.

It is still too early to generalise, however, until more is known of the factors governing the supply of phosphate to the plant in our soils. For example, the easily soluble phosphate on soil from certain parts of Lugazi Sugar Estate is of the order 0·001 (soluble in N/2 acetic acid), a very low figure. On the other hand, these soils give consistently good crops so it is clear that the content of easily soluble phosphate is not in itself an infallible index of soil fertility.

Throughout the year a striking feature of the work on easily soluble constituents has been the wide limits of variation found within very small areas. This is very probably bound up with erosion as it is a characteristic of an undisturbed profile on our principal soil type that the top six inches contains a very much larger amount of easily soluble constituents, more particularly phosphate, than do successively lower depths. It has, in fact, been possible in certain cases to demonstrate to natives, by means of a field test for phosphate, how land which they were cultivating was suffering from erosion.

A soil type of considerable interest has been found to exist on the Kaiso beds on the floor of the Albertine Rift. These beds are of tertiary origin and are fossiliferous. The soil developed on them is black, calcareous, and rich in phosphate. The type has been recognised throughout the whole length of the western rift from Lake Edward to Lake Albert. It lies entirely in an area of inadequate rainfall but under irrigation it may in the future prove a useful asset.

Another discovery of importance has been that of a concretionary layer of calcium carbonate at a few feet down in the belt of soil round Lake Kyoga. This led to the discovery of a similar layer of considerable thickness on the banks of the Nile and of the fact that ant-hills in these districts commonly contain calcareous fragments. These observations are of wide interest, firstly, in connection with the incidence of mvule (*Chlorophora excelsa*), a tree of high calcium requirement. It is clear that given such an accumulation of calcium a mvule tree might make quite good growth on what is superficially a soil poor in calcium. The scope of our enquiry into the possibilities of mvule as a calcium indicator is thus greatly extended.

Secondly, this concretionary layer of calcium carbonate throws light upon a vexed question, namely, the proper attitude to adopt to termite hills. It may be that the factor determining whether a termite hill is going to be fertile or no is whether the termites are bringing up calcium and other plant food from an accumulation such as has been described above.

A further observation of interest has been made in the course of an experiment begun by the Assistant Botanist on the Kampala Plantation to investigate the effect on the coffee seedling of shade and mulch. The work of harvesting, measuring and weighing the plants was carried out by this section owing to the Assistant Botanist's absence on leave and soil analysis made at the same time revealed the striking fact that the easily soluble phosphate and potash was considerably higher on the shaded soil. This point will be investigated further during 1935.

Considerable help has been received throughout the year from the Geological Department and we are indebted to them for a plentiful supply of geological maps which have been a great help in systematising the soil survey. We are also particularly indebted to Mr. W. C. Simmons of that Department for identifying and reporting upon numerous rock samples. His advice has been most valuable in assisting us to a proper understanding of our soils.

Essential Oils.

This year's work has been confined mainly to Lemon Verbena, Vetivert and Lemon grass. Stocks of planting material of Geranium (*P. radula*) and Singapore patchouli (*Pogostemon patchouli*) are being built up but no distillations of these were carried out as all the material was needed for propagation.

Lemon Verbena (*Aloysia citriodora*).

A sample of this oil was sent to Messrs. R. C. Treatt and Company, London, to whom we are indebted for the following report:—

> "This oil would have to compete on the market with (1) a Lemon Verbena oil now being distilled in Grasse and to-day worth 50/- to 60/- per lb., (2) a commercial Verbena oil which is in fact a very high grade Citral distilled over the Verbena plant and to-day worth 16/- to 20/- per lb.
>
> "Your oil is quite definitely inferior to (1) but preferable to (2). On the other hand there is always considerable 'sales resistance' to a new product and for this reason we are not at present prepared to put a higher value on it than that of the commercial Verbena oil, namely, 16/- to 20/- per lb.
>
> "I am at present unable to say what quantity of this oil we could place on the market but could give you an idea if I can have three or four pounds of this oil to enable various perfumers to try it out. This too would enable me to give a closer estimate of its value."

This is one of the most encouraging reports we have received and propagation is being carried on as rapidly as possible in order to provide the quantity of oil desired.

Vetivert.

Small samples of this oil were sent to Messrs. R. C. Treatt and Co. for valuation, and in the report it was stated that they were equal in quality to the Bourbon oil though not quite so good as the Java. The report calls for a trial shipment of 1 cwt. and places the value at about Shs. 15 per lb.

Lemon Grass (*Cymbopogon citratus*).

The work on this material was designed to give information on the yield of oil per acre, the time and length of cutting and pre-distillation procedure, *i.e.*, distilling green, drying for two days, and drying completely before distillation. The experimental plots were attacked by a rust just before cutting so samples of oil were distilled from rusted and healthy leaves to investigate the effect of the rust on the quality of the oil. The Imperial Institute's report shows that there is little difference between the oil from rusted and that from healthy leaves and there is therefore no necessity to pick out the rusted leaves. From the report also it is established that the grass should not be cut to ground level as the butt oil is inferior and that the drying period should not be more than two days.

The question of the turbidity of the oil referred to in the Imperial Institute's report has been investigated because all the oils forwarded had already been filtered though dry filter paper and were clear when they left Uganda. It was found that a carefully filtered clear oil at 27°C became turbid when the temperature dropped to 20°C. An oil filtered at 10°C or shaken with anhydrous sodium sulphate never again became turbid. It has also been established that 35 lbs. of oil can be obtained per acre per cut, even on poor land, and this figure may be regarded as a minimum.

Acknowledgment is due to Messrs. R. C. Treatt and Company, London, for the assistance they have given us with the essential oil work. Mr. E. W. Bovill, a director of that company, has visited us twice in the course of his trips to East Africa and his advice has been of very great value. His firm has also given us material help in supplying standard samples of oils, the valuation of certain samples, etc.

Fibres.

Work on fibres has been in continuation of that reported in the Annual Report for 1931 (Part II), namely, an investigation of the possibility of chemical retting of fibres.

In 1932 an account* was published, in the *Journal of Industrial and Engineering Chemistry*, of a series of experiments on the Chemical retting of Ramie using ammonia and sodium sulphite in dilute solution and under pressure.

A small pressure digester was obtained and samples of Ramie fibre were prepared by the method described by Messrs. Carter and Horton. A product of fairly good appearance was obtained finally but (*see* appendix 1) though quite a favourable report on the fibre was obtained it appears that no market exists for this class of product. Work on the chemical retting of Ramie has therefore been suspended. Plots are being maintained in different parts of the Protectorate for observations on growth and to provide a supply of planting material should a market be found for the fibre.

Sunn Hemp.—The same process was applied to Sunn Hemp and samples were sent to the Imperial Institute for valuation (*see* appendix 2). A favourable report was received and the best sample was valued at £22 per ton. Work will be continued during 1935 to obtain information on the cost of the process.

Beeswax.

Samples of Uganda beeswax were submitted during the year for valuation by certain British firms, one of which condemned the wax because its acid value was considerably below the lower limit laid down in the British Pharmacopæa. To investigate this point acid values of a number of samples of Uganda wax were determined and compared with the acid values determined at the same time on waxes from other sources.

	Description of Sample.	*Acid Value.*
I.	Uganda wax, as submitted for valuation	15·9
II.	Uganda wax from same source as I	19·8
III.	Toro wax	17·3
IV.	Toro wax	18·1
V.	Ankole wax	16·9
VI.	Ankole wax	18·0
VII.	Kigezi wax, brown in colour	17·2
VIII.	Kigezi wax, yellow	16·0
IX.	English wax	16·0
X.	English white wax	21·8
XI.	Tanganyika wax as exported	18·6
	British P. specification	17·23

The values for Uganda wax tend to be low but not unduly so, in view of the low figure obtained for one sample of English wax. The local waxes were all rendered by Mr. Chorley in these laboratories so that the question of adulteration cannot arise. If the *B.P.* specification is not used as a check of purity it would be interesting to know for what purposes this specification is required and also what percentage of imported wax is used for these purposes.

W. S. MARTIN,
Agricultural Chemist.

G. GRIFFITH,
Assistant Agricultural Chemist.

*Carter and Horton, *J.I.E.C.*, 1932, pp. 1162—3.

Appendix No. 1.

IMPERIAL INSTITUTE,
LONDON, S.W.7.

29th May, 1934.

SIR,

I enclose for your information a copy of a report which has been forwarded to His Excellency the Governor on the four samples of ramie referred to in your letter No. 825/350 of the 4th April last.

It will be seen from the report in order to market ramie in this country it is at present necessary that it should be forwarded in the form of hand-cleaned China grass, a specimen of which is enclosed for reference. The current value of China grass in the United Kingdom is £40—£50 per ton c.i.f. London.

It may be mentioned, however, that the Imperial Institute has recently been informed by a London firm that they would be willing to purchase supplies of ramie bark (at a price of about £15 per ton c.i.f. London) which had been merely stripped from the stems and dried, no attempt being made to remove the brown pellicle by scraping. This bark must be obtained from the type of plant which bears leaves with a downy under-surface of silvery appearance. If the Uganda plants are of this variety, and it is considered worth while to proceed further in the matter, a sample (not less than 1 cwt.) should be forwarded to the Imperial Institute in the first instance, as an indication of the material which could be produced in commercial quantities. The question could then be taken up with the firm and their opinion obtained as to the suitability of the bark for their purposes.

A similar possibility was foreshadowed a few years ago when a firm known as the Abbey Syndicate were endeavouring to utilise ramie for spinning in admixture with wool, and stated that they would be willing to purchase supplies of the stripped, unscraped, dried bark. Such an outlet for the fibre was only available, however, when abnormally high prices were ruling for wool. I am informed that owing to the fall in the price of wool about two years ago, development was suspended and that the Syndicate has now ceased to function.

I am, Sir,
Your obedient servant,
(Sgd.) W. FURSE, *Director.*
(Lt.-Gen. Sir William Furse).

Appendix No. 2.

IMPERIAL INSTITUTE,
LONDON, S.W.7.

F. 1874/2

REPORT ON SUNN HEMP FROM UGANDA.

The two samples of Sunn Hemp which are the subject of this report were forwarded to the Imperial Institute by the Director of Agriculture, and are referred to in his letter No. 2328/350 of the 29th August, 1934.

It was stated that the Department's Chemist had been attempting to devise a chemical process for the extraction of Sunn Hemp fibre and that the samples submitted had been prepared by him as follows:—

Sample A.—Prepared from 100 stems. Stems stripped and the ribbon digested with 1 per cent. ammonia and sodium sulphite.

Sample B.—Prepared from 200 stems. Stems digested with water under pressure, then stripped. The ribbons were digested as above.

It was desired that the samples should be examined in comparison with a series of 26 samples, prepared by various methods, previously submitted to the Imperial Institute and dealt with in Imperial Institute report of the 4th November, 1932.

Description.

Sample A.—Weight 2 oz.

This consisted of very clean, well separated, fairly soft, fine fibre of pale yellowish-brown colour and fair lustre; portions of the sample, however, were somewhat coarse and gummy towards the butt ends. The strands varied in length from about 2 to 4 feet, being mostly from 2½ to 3½ feet. The strength was on the whole good.

Sample B.—Weight 5½ oz.

This consisted of clean but imperfectly separated fibre. It was composed of narrow ribbons of rather fine, matted fibre, the butt ends of which were hard and gummy, and it seems probable that there would be considerable loss in combing such material. The fibre was generally of pale greyish-green colour and fairly good lustre but was slightly harsh to the touch. The length varied from 2 to 3½ feet, being mostly between 2½ and 3 feet. The strength was variable but on the whole good.

In comparison with the previous series of 26 water-retted samples which were the subject of Imperial Institute report of the 4th November, 1932, the present Sample A was much superior in colour (the earlier materials were generally greyish-brown) and was rather softer and better separated; it was, however, not so lustrous as some of the samples included in the series.

Sample B on the other hand was similar in colour and character to those previously examined and bore a close resemblance to No. 8 of the series, which represented a 50 lb. seed rate, 108 days' growth, and had been stripped wet after 5 days' retting.

Commercial Value.

The samples were submitted to the firm of merchants in London (Messrs. Wigglesworth and Co., Ltd.) who valued the previous series. They furnished the following reports:—

"*Sample A.*—This is a light-colcured material, of average length, cleaner, softer and better prepared than Dewghuddy, which it resembles, and we should value it at about £22 per ton. We believe it would be quite saleable in substantial quantities.

"*Sample B.*—This resembles the Madras type of Sunn between that and Itarsi. The colour is dingy, greyish-green; strength satisfactory; cleaning is right, but the fibre is rather matted. We should assess this at about £18 per ton.

"These values compare with Fine Dewghuddy at £22, Sewnee at £18 and Jubblepore at £17."

Remarks.

It will be observed that the present samples, prepared by chemical treatment, were on the whole superior to the water-retted samples which formed the subject of Imperial Institute report dated 4th November, 1932, and that such fibre should realise good prices.

In this connection it is noteworthy that at the date of the merchants' valuation the market prices of India Sunn hemp were practically the same as at the time of the earlier report. The best of the water-retted samples then examined (Nos. 5, 8, 10, 17) were valued at about £16 per ton, whereas the present materials were considered to be worth respectively £6 and £2 in advance of this, Sample A being regarded as equal to Fine Dewghuddy. It might be worth while therefore to consider the possibility of the production of such fibre on commercial lines. If large-scale experiments should be undertaken it would be desirable in the first instance to send a bale or two of the fibre to the Imperial Institute for trial sale and report.

22ND NOVEMBER, 1934.

Appendix No. 3.

IMPERIAL INSTITUTE,
LONDON, S.W.7.

O. 2357/4.

REPORT ON LEMON GRASS OIL FROM UGANDA.

The samples of oil which are the subject of this report were forwarded to the Imperial Institute by the Director of Agriculture and are referred to in his letter No. 2295/350 dated the 27th August, 1934.

The oils had been prepared experimentally and it was desired to ascertain their quality and commercial value.

Description.

The description of the samples and the quantities received were as follows:—

Sample.		*Quantity.* cc.
A	From freshly-cut grass	600
B	From grass dried under shade for two days; filtered cold	770
C	From a sample of grass picked free from rusted leaves	120
D	From badly rusted leaves	120
E	From butts	44
F	From leaves only (very dry)	120

All the samples as received were turbid owing to the presence of moisture. After filtration through paper they were clear, and varied in colour from orange-yellow in the case of Sample A to pale greenish-yellow in the case of Sample D. Samples E, C and B were somewhat paler than A; F closely resembled D in tint.

Results of Examination.

The oils were found to have the following constants, which are shown in comparison with the figures obtained for previous samples of lemon grass oil from Uganda which were the subject of Imperial Institute reports dated 7th December, 1931, and 22nd December, 1932, and with recorded figures for *Cymbopogon citratus* and *C. flexuosus* oils:—

Present Samples.—

Sample.	Specific Gravity at 15·5/15·5°C.	Optical Rotation aD.	Refractive Index nD20°C.	Citral (bisulphite method,) by Volume, %	Citral* by weight. %
Present Samples:					
A	0·8834	—0·10° at 17°C	1·4850	76·5	74·2
B	0·8805	—0·09° at 17°C	1·4847	74·5	73·8
C	0·8831	—0·11° at 17°C	1·4850	79·5	77·1
D	0·8812	—0.11° at 17°C	1·4850	77·5	77·1
E	0·8825	—0·30° at 16°C	1·4848	75·5	75·1
F	0·8756	—0·12° at 17°C	1·4835	72·0	71·1
Previous Samples:					
1931	0·9178	+1·43° at 20°C	1·4913	72†	...
1932	0·8846	—0·21° at 22°C	1·4859	77	...
Recorded Figures:					
C. citratus (West Indian Oil)	0·870—0·912	—1° to +0° 12′	1·482—1·489	53—83	...
C. flexuosus (East Indian Oil)	0·895—0·911	—5° to +1° 25′	1·483—1·488	70—85	...

*By the hydroxylamine method as specified in the Report of the Essential Oils Sub-Committee to the Standing Committee on Uniformity of Analytical Methods (*Analyst*, February 1934).

† By the normal sulphite method.

Solubility.—The Uganda oils were all insoluble even in 12 vols. of 80 per cent. alcohol at 15·5°C. *C. citratus* oil is recorded as being sometimes soluble and sometimes insoluble in 80 per cent. alcohol, and *C. flexuosus* oil as soluble in 1·5 to 3 vols. of 70 per cent. alcohol.

From these results it will be seen that Samples C and D contained the highest amounts of citral. The odour of Sample D, from badly rusted leaves, was decidedly less pleasant at first than that of Sample C from leaves free from rust, although after exposing a drop of each of these two oils for several hours on filter paper the difference was scarcely noticeable. Sample A, from freshly-cut grass, was considered to have the best aroma of all the samples, but there were no important differences between the odours of Samples A, C (from rust-free leaves), E (from butts) and F (from very dry leaves). The odour of Sample B from grass dried for 2 days slightly inferior to that of the other samples.

Commercial Value.

The oils were submitted to (*a*) manufacturing chemists and (*b*) essential oil merchants in London, who furnished the following observations respectively:—

(*a*) "We have now had an opportunity of examining the samples of lemon grass oil and can report that the oil is of very good quality. The physical constants are normal and the citral contents higher than the average of East India oils. We find that the aroma is finer than that of East India oil, and in our opinion Sample A is superior to B, and B superior to F.

"It is also well to know that the citral content of F is lower than that of A or B, which suggests that the freshly-cut grass should be used. Sample E is not so fine as A. Sample C, distilled from healthy leaves, is finer than Sample D, distilled from affected leaves, and the conclusion we draw is that the freshly-cut grass should be used for distillation and that leaves affected by rust should be rejected. It is also noted that the aroma of the oil is affected when the grass is dried before distillation."

(*b*) "We have now been able to examine carefully the six samples of Uganda lemon grass oil which you sent to us.

"From an odour point of view we consider that Samples A, C and F are the best, but there is not very much to choose between these samples and D and B. The latter two, however, seem to us rather 'fishy.'

"Sample E, distilled from the butts of the grass, we should definitely reject, as the smell is entirely abnormal and we should not advise distillation. Sample F, although good in colour, contains, we notice, only 72 per cent. citral, and would therefore have to be sold at a discount.

"It seems, therefore, speaking generally, that it is not worth while to separate the leaves from the grass unless this can be done very cheaply, and it seems also that the grass should be distilled at once rather than dried.

"It is curious that C and D should both give a higher citral content that A.

"To sum up, we consider that the most satisfactory oils for the market are represented by Samples A, C and D."

At the date of these reports the East Indian Cochin oil, which is the only lemon grass oil now on the United Kingdom market, was quoted in London at 2s. 11d. to 3s. per lb. c.i.f., or 3s. 4½d. per lb. spot.

Remarks.

From the results of the present investigation it would appear that the drying of the grass, if carefully carried out so as to avoid fermentation, does not seriously affect the odour of the oil. It is noteworthy that the oil from the very dry leaves (Sample F) contained the lowest percentage of citral in the series.

Some differences of opinion appear regarding the comparative quality of the samples in respect of odour, but it will be observed that there is general agreement in considering Sample A as the finest and C and F as but slightly inferior to it.

When the oil is employed for the extraction of citral, which is its principal industrial use, the odour of the non-aldehydic portion is of minor importance, and for this purpose Samples C and D, containing the higher amounts of citral, would be regarded as the best of the present oils.

7TH DECEMBER, 1934.